THE ONTARIO & WESTERN TRANSFER.

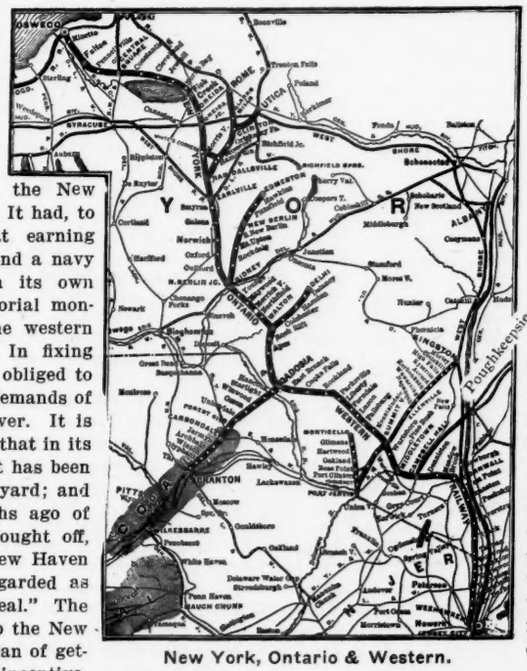
The fact forecast has become the fact accomplished; and by purchase of about 1,000 shares above a majority of the stock the New York, New Haven & Hartford has secured control of the New York, Ontario & Western. The purchase price was $45 a share, and, in fixed charges, the New Haven people figure out that the control will cost them about $460,000 a year, or about $960,000 a year if the minority stock is financed into their strong box at $40; and they assert, with plausibility, that the earnings of the Ontario will cover this expenditure, not counting increased receipts from traffic which the New Haven will bring to it. The fiscal transaction, however, mainly concerns the shareholders of the two roads and may be left there. But there are other aspects in which the transfer becomes a matter of importance to the public, and it may even be said to take a conspicuous place in the railroad history of the country.

Up to last week Wednesday, the New Haven had been a local railroad. It had, to be sure, large mileage and great earning power, a great Boston terminal, and a navy of Sound steamers; and within its own bounds an almost complete territorial monopoly. But in its relation to the western through business it was weak. In fixing through freight rates it has been obliged to submit to what it deemed unfair demands of the lines west of the Hudson River. It is hardly a strained metaphor to say that in its relation to the great trunk lines it has been a kind of colossal terminal freight yard; and a threatened paring a few months ago of coal percentages, with difficulty fought off, and which would have cost the New Haven some $300,000 a year, may be regarded as the starting point of the present "deal." The resistance of the coal companies to the New Haven's Lehigh & Hudson River plan of getting to the coal fields was another incentive.

It is primarily under the spur and stress of such a situation that the New Haven has taken its radical step. It will now have a voice in fixing coal rates; and, as it connects with the Erie at Campbell Hall, 30 miles from the Hudson River, and with the New York Central at Oneida, 122 miles west of Albany, it may have more influence in fixing rates to and from Chicago.

By this invasion of the coal fields it becomes an owner of a considerable coal field, a large coal yard for New England factories, and enters, as a factor, into the coal combination, so-called; and it proposes to become its own fuel carrier. That the coal-road and trunk-line presidents resisted this incursion, to the best of their ability may well be believed; and it would be interesting to know at their reported meeting with Mr. Mellen last week Tuesday what words were spoken and what compromises offered and rejected. But, whatever the proceedings, it is certain that Mr. Mellen, with the Ontario & Western option in his pocket, held the handle of the whip.

We mentioned last week several of the advantages to be derived from this new possession, and they have since been confirmed in the semi-official announcement of the transfer. To complete the record it may be added that the Ontario & Western, with its 500 miles of road and good equipment, has also, under its old hard and fast contract running for about 175 years, and antedating the New York Central control of the West Shore, large terminal privileges at Weehawken, opposite New York, which it reaches over 52 miles of the West Shore. This contract, subject to one or two technical differences, is strikingly analogous to that under which the New Haven uses the Grand Central Station in New York city; and contract rights of the Ontario & Western over the Rome, Watertown & Ogdensburg Division of the New York Central for 150 miles between Oswego and Niagara Falls are not to be overlooked. The contract we understand is terminable, but it would hardly be policy for the New York Central to cancel it, with loss of the business and the risk of extension of a new rival over a level country to meet the Grand Trunk and the Wabash at Buffalo and Niagara Falls.



New York, Ontario & Western.

On the negative side should be cited the risk that the New Haven incurs of a hostile combination of the great companies should it prove to be a disturber of the peace; its new coal supply is not of the highest quality; and of course it is not going to save much on the cost of its fuel unless it uses anthracite much more freely than it does now; and no large railroad is going to use much anthracite in its freight engines unless compelled to do so, for the increase in the cost of coal would outweigh any possible decrease in freight charges. Another adverse item is the cost of changing from bad to good the railroad which connects New Haven with Campbell Hall; for with the proposed double-tracking much costly leveling and straightening must be done.

It must be assumed, however, that Mr. Mellen has counted the cost; and that he intends, if possible, to make the Poughkeepsie Bridge line, with the Ontario & Western as an annex, his chief freight line to the west, involving right away the complete double-tracking of the Highland Division and of the Berkshire Division to New Haven. He has never looked with favor on the New York harbor route for freight, involving the use of the New York division, already taxed with a great passenger traffic; and his experience with strikes in New York city has probably not weakened this opinion. How that transfer of freight to his northern route will affect his relations with the trunk lines —especially the Pennsylvania, not long ago supplying 50 per cent. of his through business (now reduced to about 40 per cent. by the Poughkeepsie Bridge) and the same company planning the costly Brooklyn loop to the New Haven's Harlem terminal—must be left to conjecture.

What further Kuroki flank movements in railroad strategy Mr. Mellen contemplates we do not know, but to those who are familiar with the New Haven's past history this latest stroke certainly comes as a surprise. Even if the new stroke is reckoned purely defensive, one marvels at the necromancy which he must have used to bind to his chariot wheels his old fogy board of directors in his swift and dusty progress. Indeed, we must be careful about using the term old-fogy; evidently Mr. Mellen has a united board behind him.

LOCOMOTIVE VALVE GEARS.

The Stephenson link-motion has been the standard valve gear on American locomotives since the beginning of railroading in this country, the chief reason for this being that it combines simplicity and reasonable efficiency. Simplicity has been the keynote of all progress in locomotive design in the United States rather than extreme economy either of fuel or of water. Because of this fact, the deficiencies of the Stephenson gear, with its irregularity of steam distribution under various conditions and its excessive weight of moving parts are complacently put up with, and, of course, freely admitted; nevertheless it is used to the practical exclusion of every other kind.

Small port openings when running at high-speeds with short cut-off, excessive wire-drawing of the steam during admission, restricted release and consequent high back-pressure, and early exhaust with excessive compression, are inherent faults of the Stephenson link-motion and slide valve gears. Various other forms of valve gears have been devised to overcome the deficiencies of the link motion gear and to give a good steam distribution under all conditions. Most of them, while giving better steam distribution, perhaps, have been so complicated and the cost of maintenance has been so high that they have never had any practical application in service. It is not likely, however, that the link-motion slide-valve gear steam distribution can be excelled by any mechanism equally simple, and if improvement is desired something more complicated will have to be accepted. After all, there is not a large margin for improvement, all factors considered, and it is safe to say that any gear which shows any appreciable increase in cost of maintenance over the form of gear now in general use can expect little consid-

eration, since the advantages it may have in economy of fuel and water would be offset by increased running repairs and greater time out of service. On the other hand, the maintenance cost charged to gears used in present practice does not by any means represent the minimum obtainable, since the imperfect steam distribution is not only a large factor in causing wear of the gear itself, but causes wear and tear to many other parts of the locomotive as well. Therefore efforts of designers of substitutes should be directed toward the attainment of the dual object of improved steam distribution and decreased maintenance. Only under these conditions would a more complicated mechanism find favor.

Last week a description of a new valve mechanism designed to accomplish this dual object was given in these columns, and another is presented elsewhere in this issue. Each has been tested for a considerable period in various kinds of service on the road, most of the time in fast passenger service. Although the mechanisms differ radically in design, the records of both locomotives show each to be what the shop man calls "a good roundhouse engine"; that is, running repairs are light, the engine rarely needing attention beyond the necessary terminal work at the end of each run. As to the other essential feature—the steam distribution—the indicator cards tell all that is to be told.

Operation of the New York Subway.*

The Subway in New York City is now in actual operation and those who have watched its progress toward completion with many hopes and possibly some misgivings can form some definite conclusions about its capacity, its sanitary conditions and the success of the project in providing real rapid transit. Beginning Thursday evening, October 27, at seven o'clock, five hours after it had been formally opened, the Subway from City Hall to Broadway and 145th street was thrown open for general use. The curious public swarmed into the stations and crowded the trains to the utmost until late at night and the new road had a severe test. In the first five hours up to midnight, 111,881 tickets were sold. Many persons rode continuously on the trains up and down. The receipts for the first day, amounting to $5,594, were given by the Interborough Company to the public hospitals of the city.

On Friday, 24 hours, 319,000 tickets were sold; on Saturday about 350,000, and on Sunday 309,875. Sunday's crowds of sightseers were bunched between noon and seven o'clock in the evening, and for most of that time the trains and platforms were packed and jammed. On Monday, the number of passengers carried dropped to about 240,000 for the 24 hours, and this is probably a fair estimate of the number of people who can be expected to use the new line regularly for the present, now that the novelty has worn off.

The four elevated lines in Manhattan, parallel to the Subway, carry about 500,000 passengers a day, and the Subway will relieve the congestion on them to the extent of probably 100,000 passengers a day. The two east side lines will not be much relieved until the east branch of the Subway is opened. The Third Avenue line is relieved of some of the local traffic below Forty-second street. The most relief will be experienced on the local trains of the two west side lines south of One Hundred and Tenth street. Above that street the Subway and the elevated road diverge and only a small part of the persons living between the two lines who have used the express trains on the elevated road will get to their offices any quicker by the Subway trains.

The relief on the surface street car lines was apparent at once. It is reasonable to assume that, of the 240,000 passengers carried in the Subway, at least 125,000 came from the surface cars, and the same conditions hold in this case as in considering the effect on the elevated lines. On the east side lines particularly, the surface cars have been relieved of the uncomfortable crowding below Forty-second street. Above Forty-second street on the west side the conditions on the surface lines were not so bad and the change has not been so apparent.

As yet there has been no change in the tentative time-table which was put into operation on the opening day. This table, which was printed in these columns last week, provides for about half the maximum number of trains for which the road was designed, and the first few days' experience has shown that during the rush hours the number of trains now run is inadequate, though quite sufficient during other hours of the day. The express trains, stopping at three stations between City Hall and Ninety-sixth street, and, with the local trains to carry passengers to local stations north of Ninety-sixth street, accommodate practically the entire population of the upper west side and a large part of the suburban passengers who come in to the Grand Central Station. These people have been quick to take advantage of the new service and as a consequence most of the expresses are uncomfortably crowded. Beyond Ninety-sixth street, where all trains run local, only a handful of passengers are carried in the local trains, and there is plenty of room in the express trains. During the rush hours the local trains as well as the expresses are crowded below Forty-second street (Grand Central Station), but above there they carry chiefly passengers arriving at express stations on expresses who are destined to some local station beyond. Running a few additional local trains during the rush hours and running the maximum possible number of expresses, at least between 7.30 a.m. and 9.30 a.m. and from 4.30 p.m. to 6.30 p.m., would probably take care of the normal traffic for the present without uncomfortable crowding of the cars and platforms. Not all of the cars ordered have yet been delivered and only about 45 trains are in use, so that more frequent trains are hardly possible unless some of the local runs are shortened and the cars thus released used in express service.

The ventilation in the tunnel seems thus far to be good and only a few complaints have been made on that score. In hot weather the atmosphere in the cars will undoubtedly be close and perhaps stuffy; but there is no likelihood of such serious trouble as has been encountered in the ventilation of the London tubes. The stations are clean, light and attractive in every way except for the omnipresent advertisements, which may be profitable but which are certainly unsightly and out of harmony with the handsome walls. At some of the stations, notably at the Brooklyn Bridge express terminal, the arrangement of ticket-sellers' booths is not all that could be desired and long lines of passengers are kept waiting their turn at the windows, extending during the worst crush even out on to the street above. In other respects the entrances and exits to the stations are well placed and of ample width to handle large crowds safely.

Of the most interest to the general public, however, aside from curiosity about the cars and stations is the running time of the trains. So far, at least, this has not been altogether what was expected. During the slack hours both local and express trains have made some good records, but in the rush hours the schedules announced have not been accomplished. There have been several failures of motors under the cars, resulting in delays of from 20 minutes to 35 minutes; and the unexpected crowds to be handled at stations have caused numerous minor delays which, while not blockading the line have disarranged the time-table badly. The running time from One Hundred and Forty-fifth street to Brooklyn Bridge for the express trains was announced to be 25½ minutes. During the rush hours with no delays of importance other than those at stations to take on and let off passengers, the actual time is between 35 and 40 minutes, about five to ten minutes slower than the express trains on the Ninth Avenue elevated. For the local trains, the running time between these two stations is actually from 50 to 55 minutes during slack hours, or a little slower than the Sixth Avenue elevated local trains. The chief delays occur above Ninety-sixth street, where all trains are for the present run on the local tracks running as locals to One Hundred and Forty-fifth street, which is for the present the northern terminus. The switching arrangements at this terminal are not adequate and some delays in starting trains have occurred there. When the single express track is put in service from One Hundred and Forty-fifth to Ninety-sixth street most of the delay at the upper end will be avoided. Between City Hall, Fourteenth street and Grand Central Station the running time of the express trains is fairly well maintained, and even during the hours of heaviest traffic the time from start to stop is four minutes to Fourteenth street and seven to eight minutes to Grand Central Station. This is less than half the time of the local trains on the elevated road, and is perhaps the most striking object lesson in "rapid transit" in the whole of the Subway operations; for many of the passengers save not only in the time spent in the cars but also from three to eight minutes in their foot journeys at either or both ends, thus making the whole saving as against the former time as much as 60 or 70 per cent.

Many of the minor delays which have occurred and which will continue to occur for some time yet are always to be expected in opening such a great establishment. Most of the employees are new men who have had but little training in their duties and none at all in handling such large crowds. They have not yet acquired the knack of making passengers "step lively," and the passengers themselves have not learned how to crowd into the new cars with enclosed platforms with the least resistance and the greatest speed. The motormen, quite properly, are a little cautious about running up to signals and do not seem to take advantage

*This Subway, or underground railroad, begins at City Hall Park, 1 mile from the southern end of Manhattan Island, and runs north under Elm street, Fourth avenue and Park avenue to Forty-second street and the Grand Central Station. It turns west on Forty-second street to Broadway and then north under Broadway to the north end of the Island at Kingsbridge. The north end of the line for about a mile runs on an elevated structure. At One Hundred and Fourth street an east side branch turns off from the main line and runs east under Central Park to Lenox avenue, thence north to the Harlem river and One Hundred and Forty-fifth street and under the river into the Borough of the Bronx. It will terminate at Bronx Park. A description of the engineering features of the tunnel was printed in the *Railroad Gazette*, September 4, 1903. Other articles on the history, traffic features, cars, signals, etc., were printed Sept. 16, Sept. 30 and Oct. 7 of this year.

of the full accelerating power of the motors in starting out from stations. At the interlocking plants the operators are not yet expert enough in their duties to handle the trains with minimum loss of time. There have been some delays due to signals failing to clear because of the fluctuations of the power signal currents, but aside from that, the whole installation of signals has been working with great success. The accidents to motors and control apparatus, hot boxes and similar breakdowns are bound to occur with equipment which has not been thoroughly broken in and no one can be blamed for such failures.

It is announced that on November 10, the east side branch from Ninety-sixth street and Broadway to One Hundred and Thirty-fifth street and Lenox avenue will be opened. The delay has been caused by a desire to get the main line running smoothly.

The Subway needs a little time to "find itself," of course. The general public is not so ready to accept reasonable excuses as it is to make complaints. There is no need for either complaints or excuses.

Gross Earnings for September.

Railroad gross earnings for September as a whole show good increases. The gains are larger than the month before and are general throughout all sections of the country. The only railroads reporting losses are those in the anthracite region. For the month, 91 railroads report an increase in gross receipts of $2,589,768 over September of last year. This is compared with an increase on 97 roads in August of $1,551,206. Of 60 of the more important railroads reporting earnings for September, 37 show increases and 23 decreases; but the losses, with only a few exceptions, are small. In the Middle and Middle West, the larger traffic resulting from the Louisiana Purchase Exposition, has aided materially in increasing the receipts of the east and west trunk lines, and of some others. This traffic did not begin to be heavy until September. In the South and Southwest, the railroads have had a heavy movement of cotton. The movement in this commodity began much earlier this year than last and the receipts at southern ports during September were over 1,000,000 bales, as against half that number in September, 1903.

Earnings, when divided geographically, show that conditions have been most favorable among the Southern railroads. In this group, 11 roads report an increase of $1,063,668 for the month, only one road showing a decrease. Other returns may be summarized as follows: Middle and Middle West group (13 railroads), increase, $549,009; Southwestern group (10 railroads), increase, $530,137; Northwestern and North Pacific group (12 railroads), increase, $468,265; Trunk line group (seven railroads), increase, $292,899; Anthracite group (five railroads), decrease, $397,828.

Among the separate railroads showing good increases in gross, the Wabash heads the list with a gain of $369,914. Other increases are reported as follows: Southern, $351,999; Missouri, Kansas & Texas, $300,542; Canadian Pacific, $283,875; Illinois Central, $224,872; Chicago & North Western, 223,293; Atlantic Coast Line, $196,249, and New York Central & Hudson River, $194,389. The heaviest loss in receipts was made by the Great Northern, which showed a decrease of $311,350. This was probably the result of the smaller movement of wheat in the Northwest as compared with the season of 1903. Other decreases in earnings reported were: The Reading Company, $253,437; Lehigh Valley, $201,784; Erie, $200,822; Grand Trunk, $91,373, and the Denver & Rio Grande, $88,100.

The Long Island Railroad is preparing to electrify its main line and branches within a radius of 15 miles from its terminus at Long Island City; and by using the power house which will ultimately serve for the line beneath the East River to Manhattan, and which is now partly finished, the company expects to get some of the work ready for next summer's business. At the present writing the Rockaway Beach division has been equipped with third rail, and the main line as far out as the Belmont race track. The Manhattan Beach and Flushing divisions will be equipped later. It is expected to have the two lines first mentioned in operation before next summer. Power will be obtained from the new power house as above mentioned, which will be completed long before the tunnel is finished. A press despatch from Pittsburg says that orders have already been given for the electrical equipment for 122 cars.

Wabash.

The gross receipts of this road for the year ending June 30 last were $23,023,627, which includes $14,064,657 from freight and $7,045,525 from passenger traffic. The freight receipts increased $737,178 over the preceding year, and this has been accomplished in spite of a decrease of over 22 millions in the ton mileage, the losses being offset by an increase in short haul and better paying freight, bringing the average rate per ton mile up to 6.4 mills as against 6 mills in 1903, an increase of 6⅔ per cent. The passenger receipts were $910,024 greater than in 1903. Since 1897 the gross receipts of the Wabash have doubled, the increase in passenger receipts being 150 per cent. A part of this is due, of course, to the larger mileage, the length of road operated in 1897 having been only 1,362 miles as compared with 2,517 miles this year.

In net earnings the Wabash, like nearly every other road, is unable longer to keep up the handsome increases of recent years. The increase in the cost of fuel is given as 30 per cent. and unusually severe storms in the spring of 1904 are given as another cause; and the total net ($5,340,118) is only $14,951 greater than in the year before. The President states that the established policy of expending large sums for improving the physical condition of the property has been kept up. A large amount of work was done improving the main line for the World's Fair traffic and completing the reduction of grades between St. Louis and Chicago (on which work has now been in progress for four years). This latter work has now resulted in obtaining a ruling grade between these points of only 21 ft. per mile instead of 50 to 60 ft. per mile as formerly.

The report gives considerable space to the line to Pittsburg, which has been in course of construction for the last two years and which was opened for business since the end of the fiscal year. The Wabash-Pittsburg Terminal Company is owned by the Wabash, ten millions of common stock of the parent company having been issued in exchange for the stock of the Terminal company; and the Terminal company owns a majority of the stock of the Wheeling & Lake Erie. The Wabash and the Wheeling & Lake Erie have agreed to use, if necessary, 25 per cent. of their gross receipts from traffic received from the new line to meet any deficit in the interest on the bonds of the Terminal company.

The principal statistics in the annual report follow:

	1904.	1903.
Average mileage worked...	2,517	2,486
Gross earnings	$23,023,627	$21,140,829
Freight earnings	14,064,657	13,327,479
Passenger earnings	7,045,525	6,135,501
Total tons carried	11,712,011	11,525,269
Tons carried 1 mile.....	*2,400,618	*2,413,162
Average train load, tons...	286	302
Ton-mile revenue, cts.....	.646	.606
Operating expenses	$17,683,509	$15,815,662
Maintenance of way.....	3,681,608	3,700,962
Maintenance of equipm't	3,473,002	3,114,664
Conducting transportat'n	9,978,629	8,511,278
General expenses	550,270	488,759
Net earnings	5,340,118	5,325,167
Additions to property.....	1,050,746	817,289
Interest on bonds.....	3,092,423	3,034,513
Surplus	119,291	406,150

*000 omitted.

Rock Island.

The Rock Island is an intricate affair. The annual report this year supplies a lack much felt in the last report, by giving at the outset the names and relations of the companies bearing the general designation "Rock Island." The original property was the Chicago, Rock Island & Pacific Railway Company. This was one of the four large systems west and north of Chicago. The other three were the Burlington, the Milwaukee and the Northwestern. The present controlling interests in Rock Island own $69,574,750 of a total of $75,000,000 of the stock of the old Chicago, Rock Island & Pacific Railway. They formed the Chicago, Rock Island & Pacific Railroad Company, of which they held the entire capital stock of $145,000,000. To this company was also turned over the St. Louis & San Francisco system subsequently acquired. The original Rock Island Railway and affiliated lines are known as the Rock Island System, while the St. Louis & San Francisco is known as the Frisco system. The Rock Island Railroad Company, to which these two systems are made over, is itself owned by the holding company known as the Rock Island Company. This is a New Jersey corporation. Its preferred stock alone has voting power. This preferred stock amounts to $54,000,000. The aggregate investment involved, as measured by the stock (at par) and the debt capitalization is $438,000,000, and $27,500,000 of preferred stock is sufficient to control this nearly half billion of book values. The mileage of the two systems now is:

Rock Island system.....	7,258.92
Frisco system	5,107.74
	12,366.64

The capitalization per mile of this mileage is:

Stock	$10,325
Debt.	25,107
	$35,432

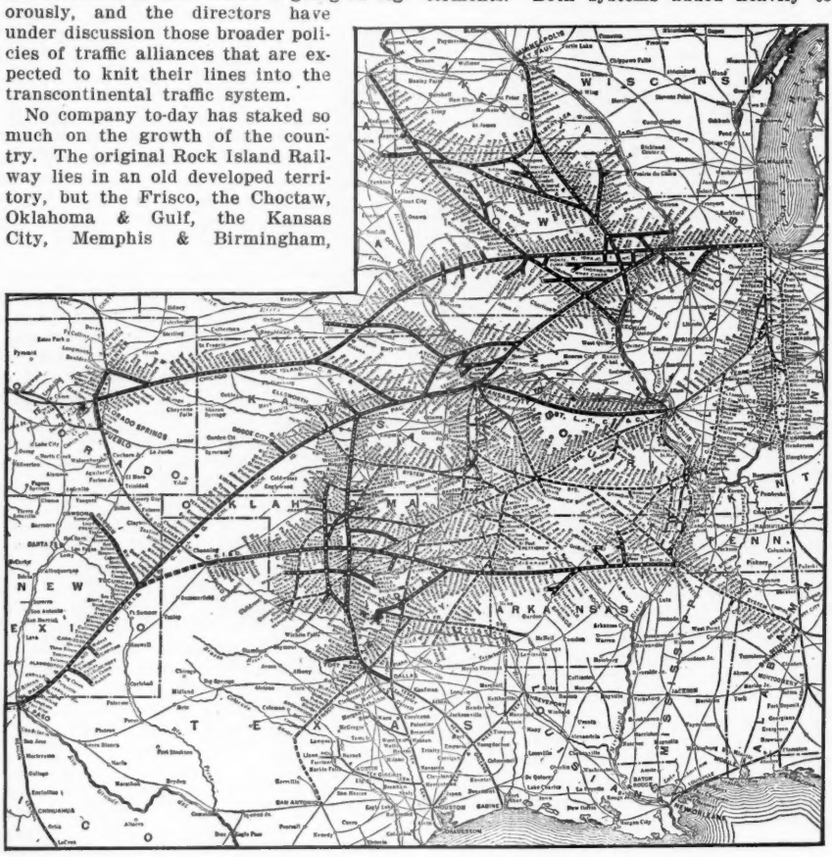
The gross earnings per mile for 1904 were $6.615.

The combined systems occupy the middle west, stretching north to St. Paul and South Dakota, west from Chicago, St. Louis, Omaha and Kansas City to Denver, southwest through Texas to the Mexican border, south to Fort Worth and Dallas; by connection to the Gulf at Houston, and by joint operation down the Mississippi Valley to New Orleans. By the Chicago & Eastern Illinois the company reaches the bituminous coal fields of Illinois and Indiana. By the Kansas City, Memphis & Birmingham it reaches into the northern Alabama coal and ore fields and by its trackage rights over the Mobile & Ohio via Tupelo it makes a direct outlet from this territory to the Gulf on the south. It is the imposing system of the great middle west.

In a peculiar sense Rock Island is an unfinished property. It is welded together out of so many diverse parts and the combination is so new that it will be some time

before the unities and system characteristics will be fully evolved. Its advent has greatly upset old traffic groupings in its territory. Physically its parts are as diverse as its traffic entities are different. Its rails are of all sizes from 40 lb. to 100 lb. The construction of branches and feeders is going on vigorously, and the directors have under discussion those broader policies of traffic alliances that are expected to knit their lines into the transcontinental traffic system.

No company to-day has staked so much on the growth of the country. The original Rock Island Railway lies in an old developed territory, but the Frisco, the Choctaw, Oklahoma & Gulf, the Kansas City, Memphis & Birmingham,



Rock Island and Frisco Systems.

and the Oklahoma and far southwest extensions rest their largest prosperity on a development of the country yet to come. In the welding of such a system the results to follow from the combination formed are highly speculative. The past year has been one to put the new system to severe test. The year has not been one of severe depression, but it has been one of hesitation. Failure of crops in some quarters, rate disorders in others, with strikes in the far west and exorbitantly high fuel and general increase in wages have made the year a severe one. The consolidated income account below shows how narrow has been the margin:

All income	$5,629,408
Expenses, taxes and interest charges..	3,552,037
Available for dividends	$2,077,371
4 per cent. on preferred stock	1,947,608
	$129,763

The company was this year sustained by the dividends of the old Chicago, Rock Island & Pacific Railway alone. The Frisco system yielded nothing except an undivided equity of about $1,000,000.

The stock of the Rock Island Railway Company was this year raised from $75,000,000 to $96,000,000, and the preferred stock from $52,500,000 to $54,000,000, while the funded debt has been increased $17,180,940. All of these increases were for increasing the holdings in the Rock Island Railway Company and the Frisco.

The railway company authorized a new mortgage for $163,000,000. Of this $82,025,000 was reserved for refunding purposes, $15,000,000 is to reimburse the company for capital expenditures, and $66,000,000 is for future development purposes under proper safeguards.

During the year $6,256,000 was spent on the Rock Island Railway. This went into new shops and equipment and general betterments. Both systems added heavily to their equipment. The Frisco system had better increases for the year than the Rock Island system, as is shown below.

Rock Island System.

	1904.	1903.	Increase.
Av. miles op....	7,205	6,978	227
Earnings:			
Freight	$31,167,006	$30,917,281	$249,725
Passenger ...	11,697,033	11,490,543	206,489
Mail and exp.	1,926,638	1,845,776	80,861
Miscellaneous.	178,814	123,018	55,795
Total	$44,969,491	$44,376,619	$592,871
Operating expenses:			
Maint. of way	$6,848,127	$6,822,550	$25,576
Maint.of equip	5,119,993	4,176,320	943,673
Cond. Transp.	18,345,418	15,811,356	2,534,062
Gen'l expenses	1,461,353	1,248,936	212,417
Total	$31,774,893	$28,059,164	$3,715,728
Net.	$13,194,598	$16,317,455	*$3,122,857
Taxes	$1,437,577	$1,319,300	$118,277
Int. and rentals.	7,062,655	7,096,730	*34,075
Total	$8,500,233	$8,416,030	$84,202
Balance .	$4,694,364	$7,901,424	*$3,207,059
Other income ..	1,333,833	1,671,487	*337,653
Available for div	$6,028,198	$9,572,911	*$3,544,713
Dividends	5,985,060	4,680,766	1,304,293
Surplus	$43,138	$4,892,145	*$4,849,006

*Decrease.

Frisco System.

	1904.	1903.	Increase.
Av. miles op....	4,986	4,419	567
Earnings:			
Freight	$25,981,912	$23,753,101	$2,228,811
Passenger ...	7,206,113	6,063,204	1,142,909
Mail and exp.	1,573,957	1,324,213	240,743
Miscellaneous.	798,791	872,839	*74,048
Total	$35,560,774	$32,013,358	$3,547,415
Expenses:			
Maint. of way.	$3,795,273	$4,099,874	*$304,600
Maint. of equip	4,606,242	3,473,797	1,132,445
Cond. Transp.	13,649,855	11,593,309	2,056,546
Gen'l expenses	1,146,313	1,021,583	124,729
Total	$23,197,685	$20,188,564	$3,009,120
Net	$12,363,088	$11,824,793	$538,294
Charges	10,514,353	9,361,468	1,152,885
Balance ...	$1,848,735	$2,463,325	*$614,590
Other income ..	415,236	508,969	*93,733
Available for div	$2,263,971	$2,972,295	*$708,323
Dividends	1,003,590	1,075,519	*71,929
Balance....	$1,260,381	$1,896,775	*$636,393
Spl appropriatns	478,654	920,646	*441,991
Balance....	$781,726	$976,129	*$194,402

*Decrease.

Both systems suffered in their transportation expenses, but Rock Island especially. Its coal bill increased over $1,000,000, or nearly 30 per cent. Its accident and damage expenses were $1,400,000, an increase of nearly half a million. All labor expense shows an increase but the increase of $250,000 in station service is especially noticeable, as this department of the service is too frequently passed over in the raising of wages. A very notable item to operating men is the decrease of $256,000 in car hire.

The operating department raised the train load on the Rock Island System from 189 to 225 tons per train. Altogether the company has had a hard year. It is to be congratulated that results were no worse. It was a severe test for a new system and save under very exceptional circumstances the company seems to have proved its ability to hold its ground. Fortunately the cash position of the company is so strong that one or two bad years do not constitute a serious menace.

NEW PUBLICATIONS.

University of Illinois Bulletin, No. 1 of volume 2, is the first of a series to be published by the University Engineering Experiment Station, which was established last December. In contains the paper on "Tests of Reinforced Concrete Beams" by Professor Arthur N. Talbot, read before the American Society for Testing Materials, June, 1904.

TRADE CATALOGUES.

Smooth-On Manufacturing Co., Jersey City, N. J., has issued a new book describing its products. These include "smooth-on" castings, an iron cement for repairing blemishes, blow-holes or defects in iron castings; smooth-on compound No. 1, an iron cement, which withstands fire and is quick-hardening, for repairing leaks or making connections in steam or hydraulic work; smooth-on compound No. 2, same uses as No. 1, but slow hardening; smooth-on elastic cement, a metallic elastic cement for inside seams of marine and stationary boilers; smooth-on joints, a silicated iron cement for connecting bell-and-spigot cast-iron pipe in place of caulking lead, or in combination with it; smooth-on cement packing, a combination of smooth-on iron cement and rubber; smooth-on scale, of which the company makes several preparations for the prevention and removal of scale in steam boilers.

Chicago Car Heating Company, Chicago, has prepared a neat circular treating of its new vapor system of car heating, which was described and illustrated in the *Railroad Gazette* of June 24 last. The circular illustrates the system and details the apparatus by engravings from wash and black-and-white drawings. There is also interesting information about car heating, and descriptions of other specialties of the company.

The O. F. Jordan Company, Chicago, has a four page circular in two colors relative to its railroad labor-saving devices, which include the Jordan pneumatic or steam power earth and ballast spreader, high bank

builder and snow remover, and Warner's adjustable unloader. There are several halftones from photographs showing the former machine and the work it will do. There are also a large number of testimonials together with a description of the device and a list of the different things that can be done with it. The unloader is also illustrated and a brief statement given of the service it will perform.

Allis-Chalmers Company, Milwaukee, Wis., issues an illustrated booklet entitled "Hydraulic Turbines and Governors." The Escher Wyss turbines used at Niagara Falls power plant, and for which the Allis-Chalmers Co. have the rights for making and selling in North America, are illustrated and described. A detailed description of the "Francis" type turbine and of the "High Pressure Impulse" type turbine is also given. Detailed descriptions and line drawings of the hydraulic governor as well as the results of tests obtained on turbines controlled by it are shown.

The Trussed Concrete Steel Co., Detroit, Mich., has issued a book entitled "Facts Concerning the Kahn Trussed Bar." It contains numerous illustrations of tests and work already completed or under way by this company; also some letters of commendation from engineers and architects relative to the Kahn system of reinforced concrete. It shows the Kahn trussed bar to be represented in all the leading cities of this country and to have been incorporated in important government, municipal, railroad and private work.

The Railway Appliances Company, Chicago, in catalogue No. 116, describes the Oldsmobile railroad inspection car, for which it is sole agent. The catalogue, which is an eight-page pamphlet, presents the Model No. 2 Tonneau Car, larger than that shown in previous catalogues and designed to carry six persons. The catalogue has a letter from W. S. Kinnear, Chief Engineer of the Michigan Central, on performance of the car.

CONTRIBUTIONS

Incomes on Private Cars.

Chicago, Oct. 22, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have read with much interest your editorial on the private-car abuse and the hearing at Chicago last week; and have also seen a great deal of comment on the refrigerator car business in the daily papers; but one or two of the most significant things brought out at that hearing appear to have escaped the attention of the reporter, and I think your readers will be glad to have their attention called to them. The assertion by Mr. Midgley that the packers probably made as much profit out of the mileage receipts on their refrigerators as from the products carried in the cars appears to have been quite fully corroborated. Mr. F. A. Spink, Manager of the National Car Line, testified that his company had leased 50 refrigerator cars from the Swift Refrigerator Co., at a rental of $20 per car per month. Now, taking the average value of such cars at $800 each, this gives a gross return of 30 per cent. per annum.

But the most startling figures on this point, were brought to light in the examination of Mr. J. S. Leeds, Manager of the Santa Fe Refrigerator Despatch Co. He testified that the cars operated by his company were leased from the Atchison, Topeka & Santa Fe Railroad, the lease providing that no mileage should be paid for use of the cars on the owner's lines. The Refrigerator Company assumes the entire cost of repairs and management, and in addition the payment of 5 per cent. per annum on the capital invested. He stated that an average of about 65 per cent. of the cars were used free on the Santa Fe system, and the mileage earned on other roads by the remaining 35 per cent. of the cars, had been found amply sufficient to pay 5 per cent. per annum to the owners, and to cover all outlay for repairs and management. If, therefore, such results can be secured on 35 per cent. of the mileage of these cars in ordinary traffic, subject to the usual delays incident to movement in slow freight trains, with about the average miles per car per day produced by cars owned by railroads, what must be the profits on packers' cars, which—owing to the grip of the owners on railroads—have to be run at the speed of express trains, often averaging 180 and 200 miles per car per day, and every mile—loaded and empty—paid for?

This kind of a searchlight, when turned on this subject, discloses evidence which must convince the government and railroad managers that serious abuses exist; and it is up to these officials to devise means by which the evils complained of may be removed. If the railroads cannot agree to act together on this matter—and everybody admits that they do not know how to go to work individually—they should at least be willing to support every such effort as this to turn the X-rays on an iniquitous business.

S. R. H.

The Manibill.

The manibill, as used on the Central of Georgia, is already well known to most of the readers of the *Railroad Gazette*. It was described in the issue of March 15, 1901, and at other times. This word was coined as a name for the blanks for waybills, freight bills, delivery receipts, notices of arrival, and other forms, when made of uniform size and so worded as to permit the whole of these documents—one of each—to be written at one writing by the use of carbon paper. The idea has been extended still farther by the addition of tissue sheets for copies to be retained either at the sending or receiving office.

The manibill has now been in constant use on the Central of Georgia for the past four years, and Mr. W. D. Beymer, auditor of the road, in answer to an inquiry, says that it takes only 1,160 manibills to cover the number of consignments formerly billed on 1,000 waybills; a statement which indicates that the proportion of waybills bearing only one entry was on that road very large. And the cost of paper is not increased at all for the quantity used is less. The manibill is 7 in. x 8½ in., therefore 1,160 manibills measure 69,020 sq. in. for the waybill portion. If the waybill of the former customary size (say one-half size 8½ x 14 and one-half 4¼ x 14) had been used it would take 89,250 sq. in. of paper, or 20,230 sq. in. more. No "Freight Received Book" is kept. Mr. Beymer says that notwithstanding an increase of 50 per cent. in freight receipts since the adoption of the manibill, there has been no increase in the number of revising clerks in the freight accounting office.

No more store room is required for records, though these are kept for seven years. It is found that about 15 per cent. of the manibills have to be corrected in weight or extensions at destination, but the clerk does not write a new freight bill except where the correction causes an increase in the amount of the bill. For a shipment where the weight is subject to correction, the billing agent omits the weight and charges from the freight bill portion.

It was expected that on the adoption of the single consignment manibill, the increase in work on the abstract, statistical and assorting desks in the accounting department, would be in exact ratio to the increase in number of bills, but it has been found that the work under the two methods of billing has been nearly equalized by the greater facility with which typewritten bills of smaller size are handled.

It was the practice under the waybill system to require of destination agents two records or reports of waybills received.

1. An abstract or report to the Freight Auditor.

2. A register of freight-bills to the agency cashier, and, in former years—

3. A record of waybills received as is now required by some lines.

Since the adoption of the single consignment manibill, the abstract to the Freight Auditor, the register to the agency cashier and the record of waybills received, are made by carbon process at one writing, saving greatly in labor. Under ordinary methods, the abstract and the register are separate and distinct, necessitating not only duplicate writing, but balancing of register against abstract or vice versa, both of which are avoided by the use of the combined abstract, register and record. The increases in work of the accounting department, if any, from the use of the single consignment manibill, will fall principally upon junior clerks who assort the billing and check it against abstracts, while the benefits from the use of the typewriter and more careful work of agents because of the use of a copy of the manibill as a freight-bill to the consignee, has fallen upon the higher salaried revising and statistical clerks.

Mr. Beymer says that where the number of consignments per waybill averages more than 1¼, and for heavy movements between large towns and cities, blanket manibills should be used. There are many advantages to agents in the single consignment form and because of the small average number of consignments per waybill under the old system, the single consignment form only is used on the Central of Georgia, although the Ocean Steamship Company, which is owned by that road, used a manibill of three consignments for several years prior to the adaptation of the idea by the railroad. The principle of the manibill can also be used for freight destined to another road to be settled for at a junction, or in interline freight accounts. In the latter event the name of the destination line is printed on the freight bill or is omitted therefrom and is inserted by the agent at destination with rubber stamp.

On the Central of Georgia a special form of manibill is made for the use of conductors of local freight trains; this has a blank for a receipt to be given by the conductor to shipper at a station where there is no agent. This is said to have proved much more satisfactory than the former plan of having such shipments billed by the agent at the next station.

A proposition has recently been made to include the bill of lading in all manibills; that is to say, to get the shipper to make out not only the shipping order but also the waybill, freight bill, etc. We do not understand that this proposition is approved by the Central of Georgia or by anyone who has had experience with the manibill. It seems probable that the percentage of corrections that would have to be made would be very large.

Great Northern Terminal Improvements at Seattle.

The city of Seattle, Wash., lies between Puget Sound on the west and Lake Washington on the east. The coast line along the sound is deeply indented by Elliot Bay and between Elliot Bay and Lake Washington is a high ridge about 2½ miles wide at the narrowest point and broadening out to greater width at the north and south ends. The business district of the city is on this ridge sloping down to Elliot Bay, which forms the city's fine harbor. The Sound waterfront is fringed with a narrow strip of tide lands at the northern end and this spreads out into a tide flat of considerable area along the southeast shore of the bay.

The Great Northern enters Seattle from the north, coming down along Puget Sound from Everett. At Interbay, a suburb of the city about four miles out from the business center, it is joined by a branch line of the Northern Pacific coming into Seattle from the northwest, and at this point there are extensive freight terminals. The Great Northern continues south until it strikes the tide lands on the north shore of Elliot Bay and then turns east, following the shore line on a pile trestle over the tide lands, until it reaches the terminal station on the water front at the foot of Columbia street. The Northern Pacific enters Seattle from the south and enters the same station which it uses jointly with the Great Northern. Both roads have freight depots and delivery tracks for city freight on ground reclaimed from the tide flats at the foot of King street, east of the passenger station.

Seattle has grown rapidly and steadily in the last few years and is now one of the four important shipping centers on the Pacific coast. Besides serving the city itself, which has a population of about 120,000, the Great Northern and the Northern Pacific handle all of the export and import business to and from the Far East, which has also increased tremendously, and the existing terminals for both freight and passenger business are old and entirely inadequate for present needs. The railroad lines and the docks both being along the busy water front has created a congestion that interferes so seriously with main line traffic as to make some change imperative in order to afford relief. The vicinity of the present terminals is the only suitable place in the city and to carry out the plans for improvements, a large amount of additional land was acquired east of the old terminals on which to build new freight and passenger stations and the necessary yards and tracks to serve them. Because of the peculiar conformation of the land on which the city is built, the only way to approach the terminal from the north other than over the present line along the water front, was to build a tunnel under the high ground of the business district. This was decided upon since it was imperative to do away with the congestion along the docks.

Work on this tunnel was begun in May, 1903. It will be 5,104 ft. long and is expected to be completed this month. The north portal of the tunnel is between Virginia and Stewart streets, and from this point it runs southeast until it reaches Fourth avenue, under which it turns on a 4-deg. curve. For the remainder of its length it follows under Fourth avenue, turning south at Jefferson street on another 4-deg. curve. The south portal is about two blocks beyond this curve, between Washington and Main streets, and within less than two blocks of the new passenger station. The object in swinging so far to the east was to get under Fourth avenue, where the only rights required for prosecuting the work could be granted in a franchise obtained from the city; and also to get sufficient cover for the tunnel, the descent from Fourth to Third avenues being so abrupt as to make a line under the Third avenue impracticable. The maximum cover over the tunnel is 125 ft.

A section of the tunnel is shown in one of the illustrations. Its greatest width is 30 ft., giving 15 ft. between centers of track. The roof is semi-circular, on a 15-ft. radius, and the vertical clearance from the outer rails is 22 ft. The lining is concrete, 4 ft. 6 in. thick at the sides and 3 ft. 6 in. thick at the crown. An invert 2 ft. deep, of two different forms, as shown by the drawing, depending on the nature of the soil, has been used for the greater portion of the length of the tunnel. The filling is coarse broken stone up to sub-grade, above which is stone ballast 10 in. deep under the ties.

Many difficulties have been encountered in driving the tunnel. The material is principally clay, of varying consistencies, and containing numerous hard and soft pockets and strata of sand and gravel, some of which carry a considerable amount of water. This water has been the cause of most of the trouble. The peculiar nature of the material and the ground formation is such that wherever water is encountered there is a tendency of the strata above the tunnel, along the hillside, to settle in an oblique direction, and constant watchfulness and care had to be exercised to avoid damage to any of the buildings above.

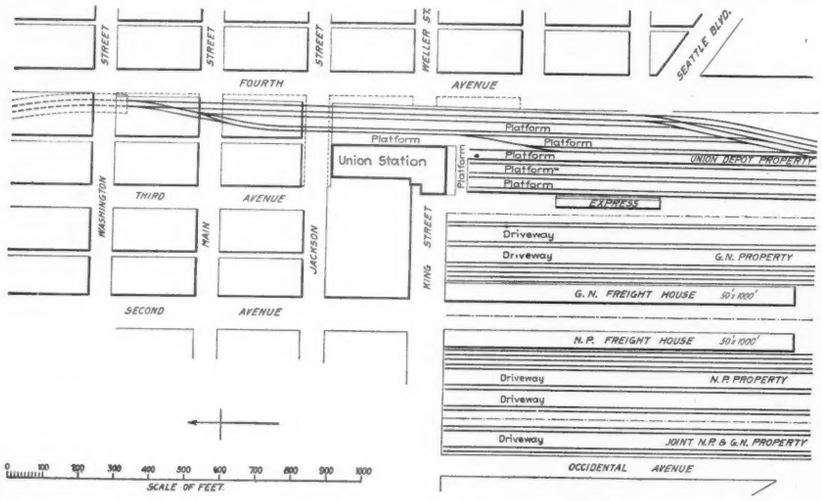
The method of driving the tunnel for most of the distance has been by bottom advance drifts at both corners, with a drift at the crown following a little behind. A second drift is then cut above each corner drift, the two extending high enough to permit the concrete of the walls to be put in up to a little above the springing line of the arch. The semi-circle is then completed by winging out from the top drift, and timber arching is placed outside of the concrete line. The core thus left is removed by Thew electric shovels, except where a threatened settlement, as explained above, makes bracing necessary, when it is removed by hand shovels. One of the most complete applications of electricity to tunnel driving that has ever been made, has been used on this work. The power, which is direct current, is obtained from the Snoqualmie Falls Power Company. Mining locomotives, Thew electric shovels, belt conveyors, electric hoists, concrete mixers, ventilating fans, etc., are all driven by electric motors.

A part of material removed from the tunnel has been used to fill in the trestle along the tide lands, and a part to fill in the site of the new passenger and freight terminals and yards. This tract is located on the northeastern edge of the broad tide flat lying southeast and south of Elliott Bay, already referred to. It was reclaimed by filling to a depth of 15 ft., which will bring the tracks 7 ft. above high tide.

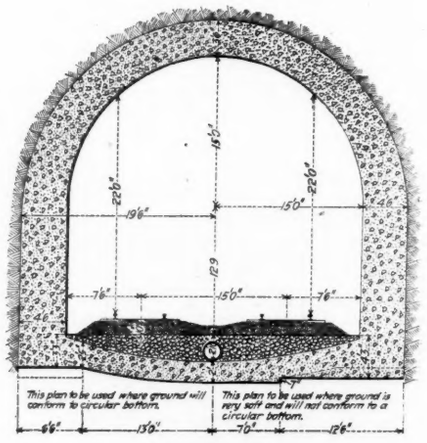
The new passenger station will be the joint property of the Northern Pacific and Great Northern, and will be on the west side of the main tracks, south of Jackson street, on the site of the old freight depots. It will extend back from Jackson street 330 ft. and will face west, its greatest east-and-west dimension being 155 ft. and the least, 95 ft. The first 184 ft. from the north end is devoted to mail, express and baggage rooms, and is one story high. Jackson street is to be carried over the tracks on a viaduct on a level with the top of this wing of the station, the roof of which will form an approach or driveway from the viaduct to the headhouse, with concrete walks on each side.

The headhouse is a three-story structure with a tower 245 ft. high on its west front. The foundations of the entire building are concrete on a grillage of I-beams for the walls and tower, and of corrugated bars for the piers, the whole resting on piling. The first story is granite, and the remainder is red pressed brick. The roof is tile with glass tile skylights and copper valleys and gutters.

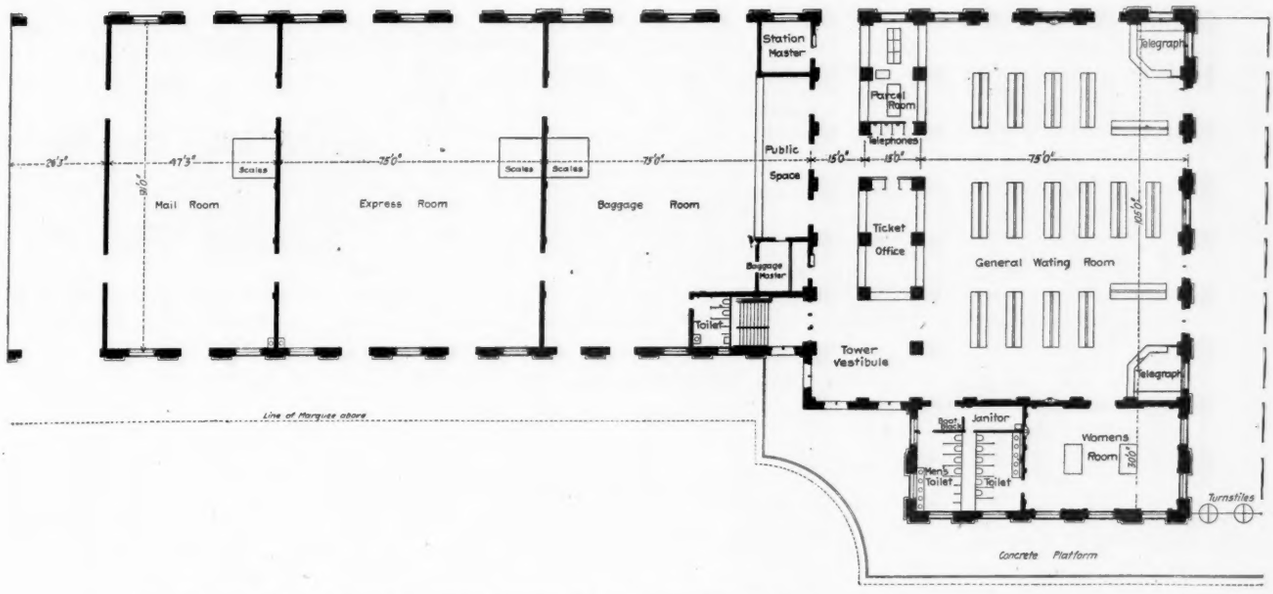
The first floor plan shows a convenient ar-



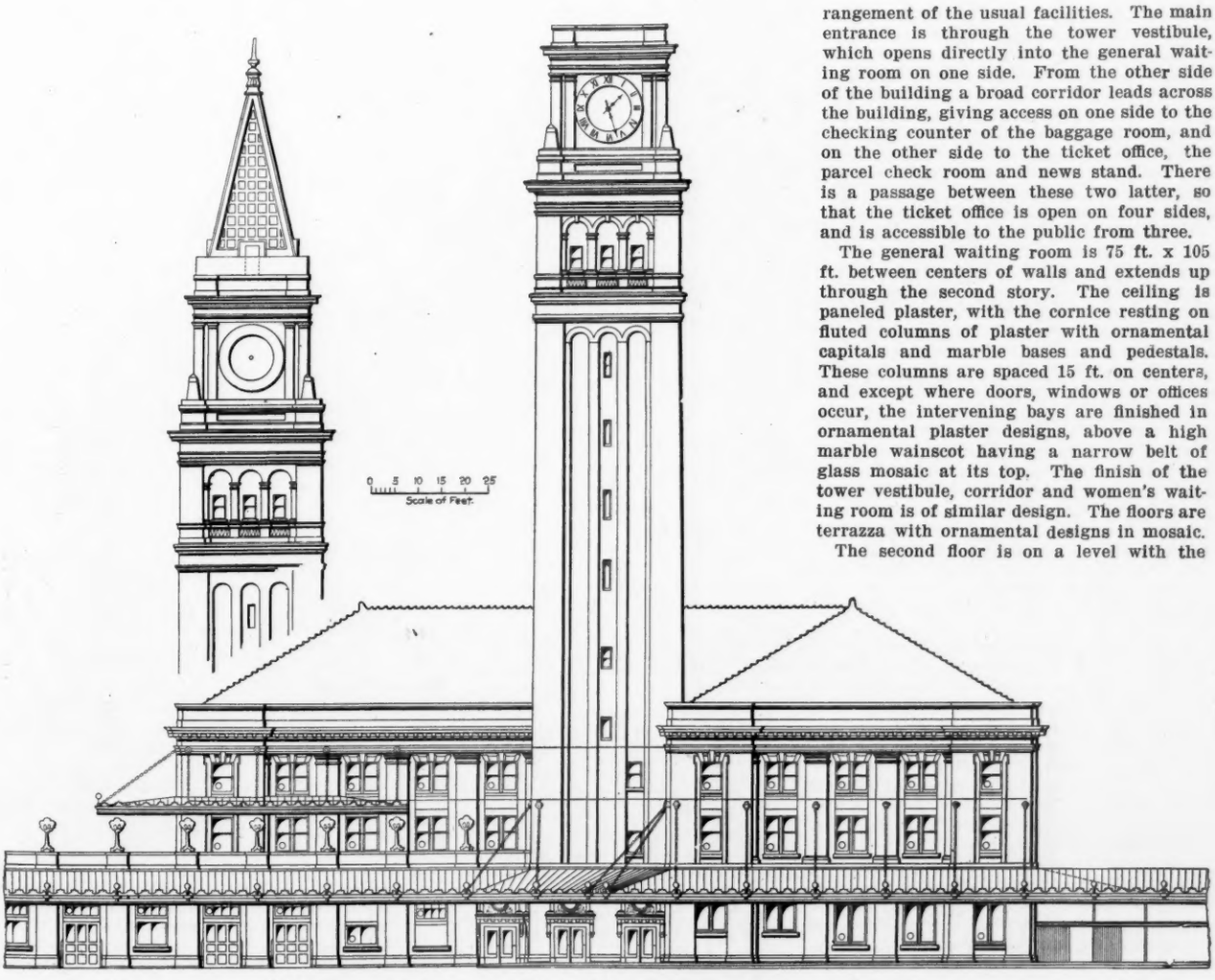
Plan of Great Northern Terminal Improvements at Seattle.



Section of Seattle Tunnel.



First Floor Plan of New Passenger Station at Seattle for the Great Northern and Northern Pacific.



Elevation of West Front of Great Northern Passenger Station at Seattle.

rangement of the usual facilities. The main entrance is through the tower vestibule, which opens directly into the general waiting room on one side. From the other side of the building a broad corridor leads across the building, giving access on one side to the checking counter of the baggage room, and on the other side to the ticket office, the parcel check room and news stand. There is a passage between these two latter, so that the ticket office is open on four sides, and is accessible to the public from three.

The general waiting room is 75 ft. x 105 ft. between centers of walls and extends up through the second story. The ceiling is paneled plaster, with the cornice resting on fluted columns of plaster with ornamental capitals and marble bases and pedestals. These columns are spaced 15 ft. on centers, and except where doors, windows or offices occur, the intervening bays are finished in ornamental plaster designs, above a high marble wainscot having a narrow belt of glass mosaic at its top. The finish of the tower vestibule, corridor and women's waiting room is of similar design. The floors are terrazza with ornamental designs in mosaic.

The second floor is on a level with the

driveway from the viaduct and a 35-ft. corridor leads back from the entrance to a transverse balcony corridor on the north side of, and overlooking, the general waiting room. On the left or east of the entrance corridor are the kitchen and dining room, while the corresponding space on the right side will be occupied by offices. The entrance corridor has terrazza floor, plaster walls with marble base, and plaster ceiling with plaster cornice and beams. The balcony corridor is finished in harmony with the general waiting room and the finish of the dining room is similar to the corridor, except that there is an oak wainscoting and oak trimmings and counters. The kitchen, pantry and serving room have a terrazza wainscot.

The west walk of the approach extends along the west front of the headhouse to a concrete stairway leading down to an entrance into the tower vestibule on the first floor. The third floor of the building is arranged for offices and the corridor floors are finished with terrazza and the office floors with vertical-grained fir. A ventilating system for the toilet rooms, slop sink rooms, dining room and kitchen will be controlled by a motor-driven disc exhaust fan on the fourth floor of the tower, blowing through an opening back over the roof. The building will be heated by steam and lighted by electricity.

The baggage and express rooms are each 75 ft. wide and the mail room 47 ft. 3 in. They have cement floors, unplastered side walls and concrete arch ceilings. As already mentioned, their roof forms the approach from the viaduct. The driveway above is asphalt and the walks, which are 16 ft. wide, are concrete. An ornamental stone parapet on which are ornamental lamp posts 7 ft. high and 15 ft. apart guards each side of the approach.

The walks on all four sides of the building are roofed over by marquees of ornate design, those on the north and west fronts of the headhouse being supported by chains from above, and the remainder by gas pipe columns resting on concrete block footings. The marquees are composed of a framework of structural steel trusses and purlins, overlaid with $^3/_{16}$-in. factory ribbed glass. A row of electric lamps, spaced 15 ft. apart, ornaments their outer edge.

There will be eight standing tracks for the station in addition to the five tracks on the east, two of which are the main line. It has not been decided what protection for passengers will be provided, though in all probability it will be umbrella sheds. The platforms between tracks and around the building are composed of 12 in. of cinder filling thoroughly tamped, above which is 4 in. of concrete, including a ¾-in. finish.

The plan shows the location of the new freight houses for the Great Northern and Northern Pacific, together with team tracks, driveways, etc. They will be 50 ft. wide and 1,000 ft. long, the north end of the buildings for 200 ft. being two stories and the balance one story. They will be of brick on concrete and pile foundation. The track sides will be open and equipped with rolling steel doors from end to end. The approach to the freight terminals will be from the present tracks along the water front, which will be retained to handle the business for the docks. The yards and freight terminals at Seattle are only intended for local requirements as all Oriental freight will be handled at the Interbay terminals.

The entire work has been under the direction of Mr. A. H. Hogeland, Chief Engineer of the Great Northern. Mr. A. Stewart, Resident Engineer, Seattle, has had direct supervision of the work, and Mr. A. D. Stevens, Tunnel Superintendent, has had charge of the construction of the tunnel. Reed & Stem, St. Paul and New York, are the architects for the station.

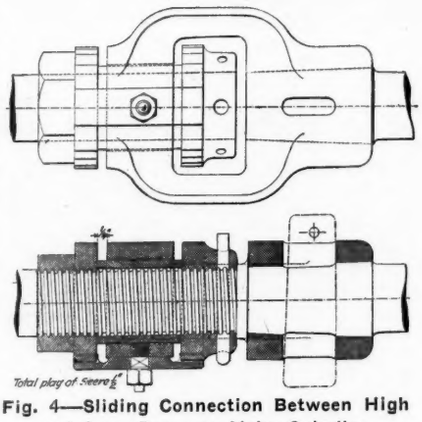


Fig. 4—Sliding Connection Between High and Low Pressure Valve-Spindles.

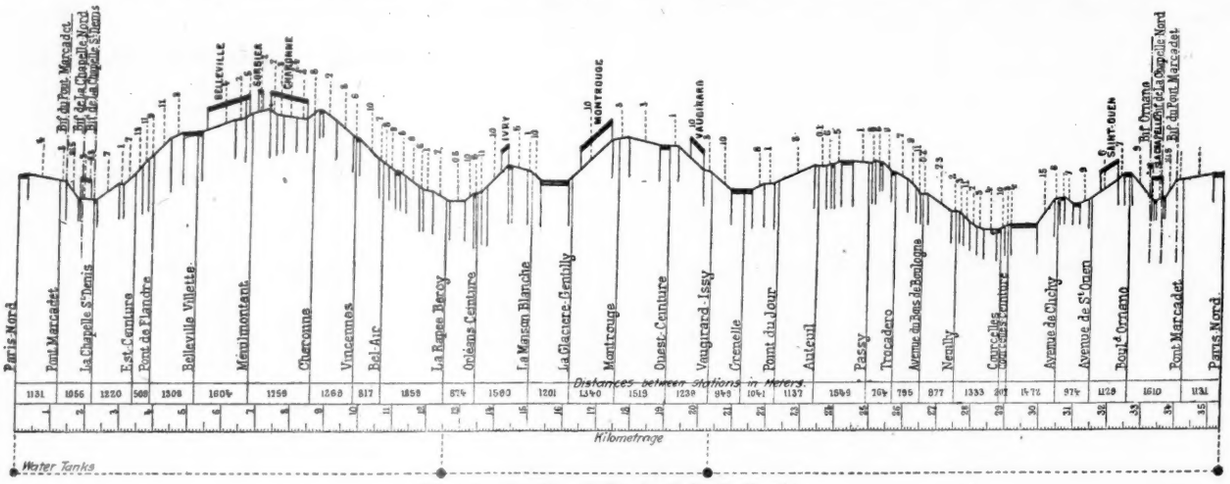


Fig. 1—Profile of Paris Belt Railroad.

New Locomotives for the Paris Belt Railroad.*

The "Petite Ceinture," or Belt Line, of Paris, has recently put into operation 15 locomotives specially designed and built for the service by the Northern of France. These engines have been built to handle the increasing passenger traffic. The conditions to be met by the designers were the following. The trains are made up of eight cars:

	Weight, tons.
2 baggage cars	16.0
5 second class carriages, with 72 seats	67.5
1 first class carriage, with 40 seats	14.5
These carry 570 passengers, sitting and standing	39.9
Total train load	137.9

These weights are in metric tons so that the train load is about 150 tons of 2,000 lbs. The circuit of Paris is 19.57 miles on the outer track, and is made in 65 minutes, of which 50 minutes is net running time with 15 minutes for station stops, of which there are 29. The average running speed is therefore 18 miles an hour, including stops. The distance between stations varies from 1,640 ft. to 5,775 ft. The profile which is given in Fig. 1 shows grades of 1 per cent. and 1½ per cent. There are a number of tunnels in which the adhesion is poor. The designers were given a free hand with the view of getting an engine of low first cost, easy of maintenance, and capable of giving the service required with a moderate coal and water consumption. It was, however, specified that the weight per axle should not exceed 36,375

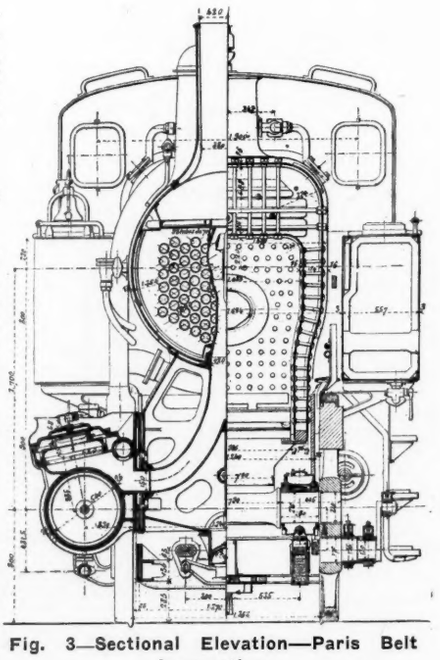


Fig. 3—Sectional Elevation—Paris Belt Locomotive.

*Abstract of an article by J. Koechlin, Chief Designer of the Northern of France, in the *Revue Generale des Chemins de Fer*, May, 1904. Translated by Lawford H. Fry.

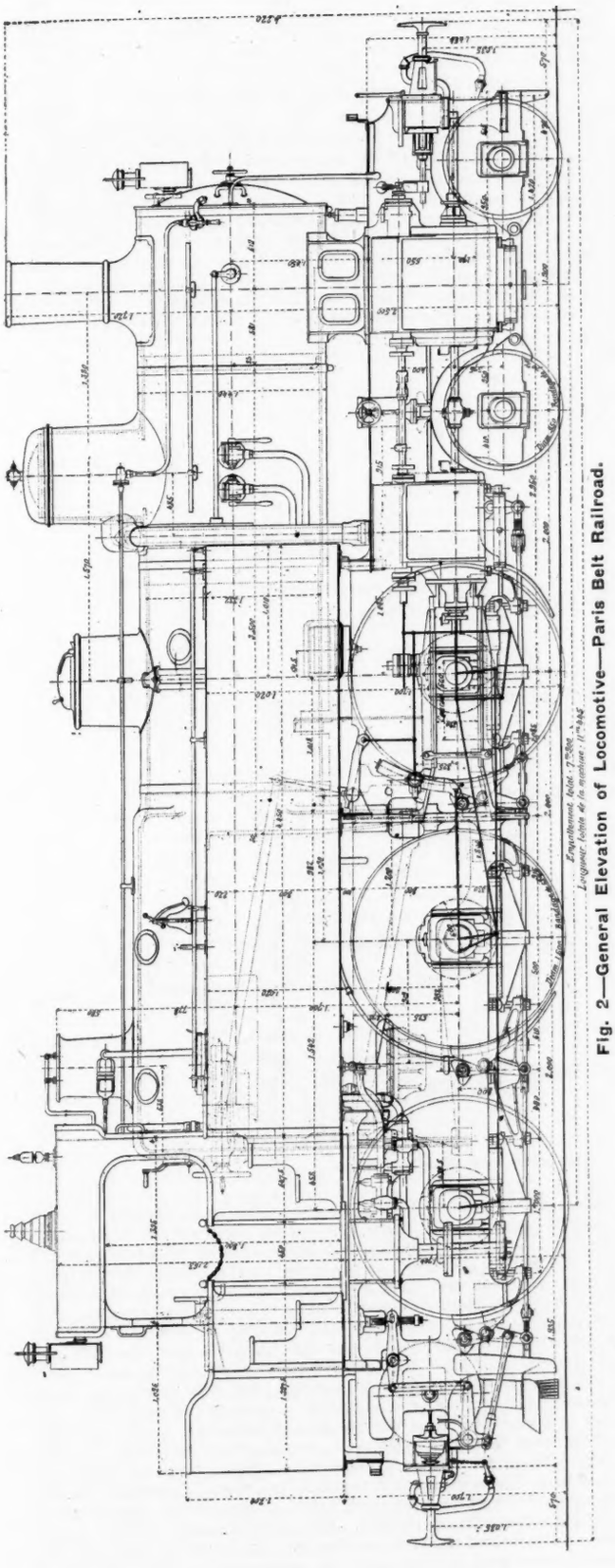


Fig. 2—General Elevation of Locomotive—Paris Belt Railroad.

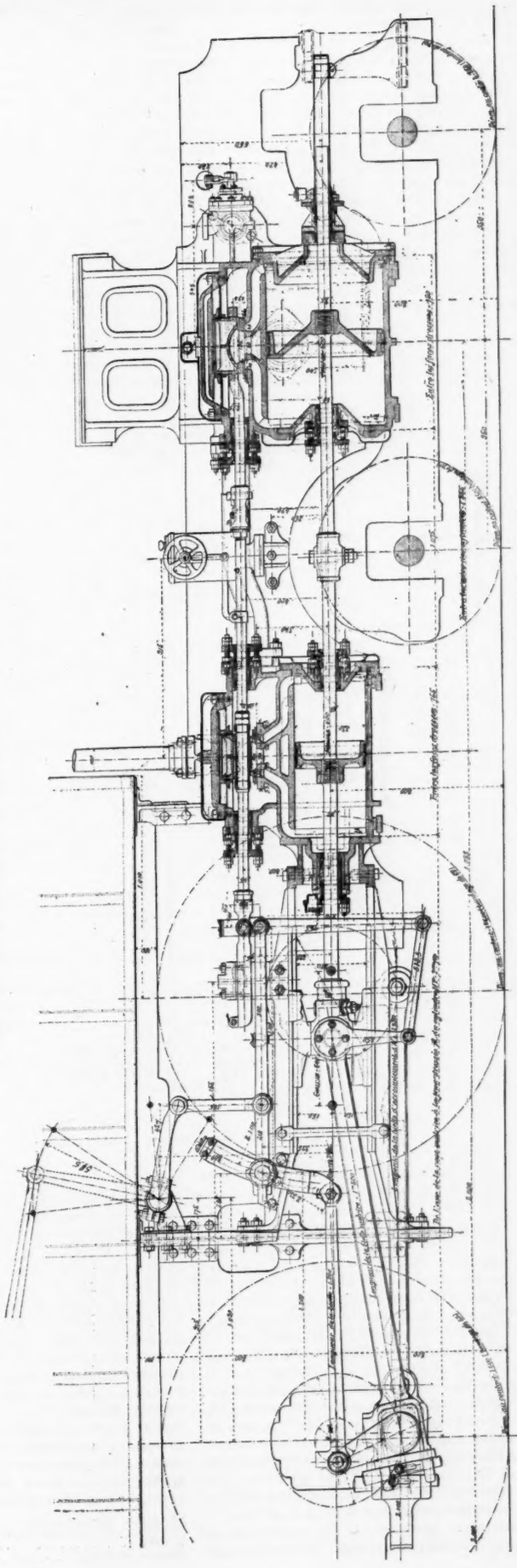


Fig. 6—General Arrangement of Valve Motion—Paris Belt Locomotive.

lbs., and that the engine should turn on a table 31 ft. in diameter.

In order to find out what type of engine was best suited to the onerous conditions of service a number of tests were made with several engines of different types. These engines were run over the road with the dynamometer car of the Northern of France, and tests were made to determine the least possible time in which the circuit could be made without an unduly high fuel consumption. The tests showed that it was desirable to have an engine with large driving wheels, and of considerable boiler capacity. The locomotive as designed and built is shown by Figs. 2 and 3, the principal dimensions being tabulated below. The type is 4-6-0 tandem compound, with side tanks and no tender, the weight on all driving axles being brought up to the maximum limit of 36,375 lbs. on each axle. The coal bunkers hold 6,600 lbs. and the water tanks have a capacity of 1,320 gal., which is enough to make a complete circuit without taking in water. The tractive effort is 22,000 lbs. It was considered advisable to use compound cylinders as these gave the best results in the tests. The compound cylinders have the advantage of developing a large tractive effort without the use of the inconveniently large cylinders necessary on a single expansion engine. They also give an economically long expansion of the steam and allow a gentle exhaust which gives good results with the fire.

The boiler is of moderate dimensions with a large grate and carries a high pressure. The boiler working pressure is 227 lbs. per sq. in., being chosen high in order to obtain a high tractive effort on starting, without the use of live steam in the low pressure cylinders. Serve tubes are used as being the best for an engine working with a high rate of combustion. Brake-shoes are applied to all wheels, including the truck. All dead weight beyond that necessary to keep the truck on the track, has been rigorously avoided, because all momentum acquired on starting must be dissipated in making a stop. The boiler has been made comparatively small to keep down the weight. This is practicable in the present service, for if the boiler pressure drops on starting, the blower can be used when steam is shut off to make a stop, and the pressure can thus be brought back to the normal.

It having been decided to use compound cylinders, the choice lay between two or four cylinders and between two or four valve motions. The two-cylinder compound has the disadvantage of making tractive power on the two sides unequal on starting, and in the Belt service there is a great deal of starting. The four-cylinder type of compound was therefore chosen, and to facilitate rapid inspection and to keep down the weight, a single outside valve motion was chosen. The use of four compound instead of two single expansion cylinders means an increase in weight of about 5,700 lbs., but the advantages of compounding fully justify this extra weight. By using the tandem compound system it became desirable to have an intermediate receiver of sufficient capacity to maintain a nearly equal pressure of admission to the low-pressure cylinders. For this purpose the right and left hand low-pressure steam chests are joined and are made of large capacity. In order to give sufficient pressure in the receiver there must be a difference between the cut-off in the high and low-pressure cylinders. As both valves are driven by the same mechanism it is necessary to delay the low-pressure exhaust by a special arrangement which is described in detail below. The main dimensions are:

Diameter high-pressure cylinder	13 in.
Diameter low-pressure cylinder	21¼ in.
Stroke	23⅝ in.
Boiler pressure	228 lbs.
Driving wheel, diameter	63 in.
Weight on driving wheels	104,000 lbs.
Weight, total, in working order	139,300 lbs.
Tractive effort:	
(*a*) Compound	22,500 lbs.
(*b*) With live steam in l.-p. cylinders	28,900 lbs.
Heating surface: Tubes (fire side)	1,396 sq. ft.
Fire-box	109 sq. ft.
Total	1,505 sq. ft.
Grate area	25.2 sq. ft.
Capacity of side tanks	1,320 gals.
Capacity of coal bunkers	6,600 lbs.

The steam distribution shows some special features. The valve motion is arranged to give considerable difference between the cut-off in the high and in the low-pressure cylinders, and has a special arrangement of starting valves. It has been found that in order to obtain the maximum economy with a compound locomotive with ordinary slide valves the steam pressure in the receiver must not exceed from 35 to 40 lbs. per sq. in. The reason for this was explained recently by M. Nadal in the *Revue de Mécanique*. To obtain these conditions in a locomotive of the above type under ordinary running conditions, that is to say with an average cut-off of 40 per cent. in the high pressure cylinders, it is necessary to have a cut-off of about 60 per cent. in the low pressure cylinders. By reducing the lap of the low pressure valves the difference between the high and the low pressure cut-off can be made about 8 or 10 per cent., but with these figures the pre-admission becomes considerable. In order to give a difference of 20 per cent. when both valves are driven from the same valve motion, a play of about one-half inch is arranged in the sleeve connecting the low pressure valve spindle to the high pressure spindle. This arrangement is shown in detail in Fig. 4. At the same time the low pressure lap is reduced by half the amount of play given to the low pressure valve.

Table 1 shows the phases of the steam distribution in both cylinders for 40 per cent.

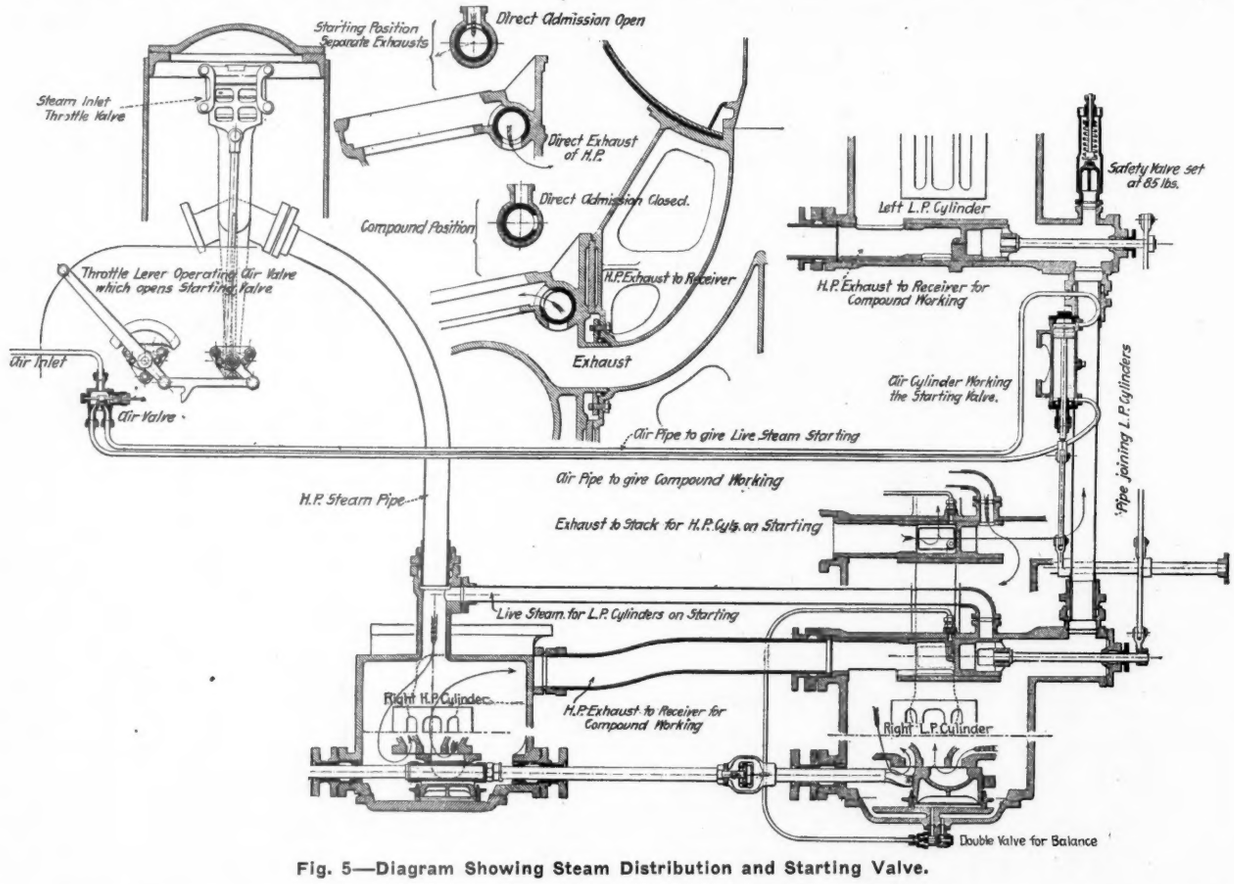


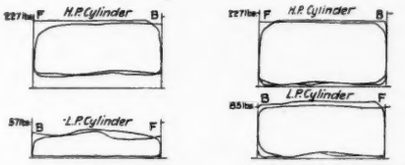
Fig. 5—Diagram Showing Steam Distribution and Starting Valve.

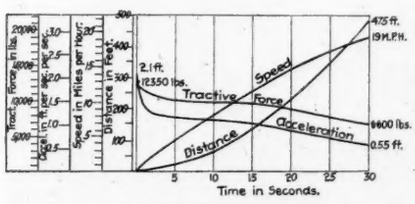
cut-off in the high pressure cylinder and also for 69 per cent. high pressure cut-off.

Table No. 1.

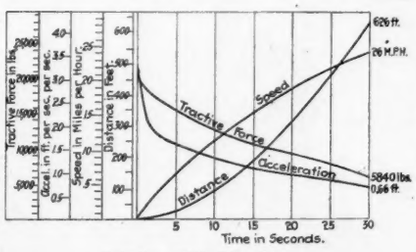
	Cut-off, 40% in h.-p. cyl.		Cut-off, 60% in l.-p. cyl.	
	H.-p.	L.-p.	H.-p.	L.-p.
Lap of valve, inside, ins..	−0.12	−0.12	−0.12	−0.12
Lap of valve, outside, ins.	1.00	0.75	1.00	0.75
Maximum steam port opening, ins.	0.43	0.43	0.71	0.71
Lead, ins.	0.20	0.20	0.20	0.20
Cut-off, p. ct. of stroke, %	40	60	60	75
Expansion in per cent. of stroke, %	35	22.5	25	15
Anticipated exhaust in per cent. of stroke, %	25	17.5	15	10
Maximum exhaust port opening, ins.	1.38	1.30	1.38	1.58
Exhaust in per cent. of stroke, %	80	85	87.5	91
Compression in per cent of stroke, %	18	13	11.5	8
Pre-admission in per cent. of stroke, %	2	2	1	1

It can be seen from the table that while this arrangement does not increase the low pressure steam port opening, it has the advantage of increasing the time that this port is open. It is found that, because of the stopping of the valve at each end of its stroke, the maximum port opening lasts from 10 to 40 per cent. of the stroke, while if there were no play in the valve spindle the valve would gradually close the port from 10 to 40 per cent. of the stroke. This arrangement has proved entirely satisfactory in service, giving a satisfactory steam distribution and working well at speeds up to 45 miles an hour. It must be borne in mind that the speed at which the spindle is moving when it picks up the valve, is very slight, the high pressure valve being near the end of its stroke, and, further, the weight of the valve and spindle which have to be put in motion, is not great.





Starting Compound.



Starting with Live Steam.

Fig. 7—Indicator and Acceleration Diagrams—Paris Belt Locomotive.

The cylinders are designed to be large enough to start the train with live steam admitted to the high pressure cylinders only, but in order to start under difficulties or to make an exceptionally quick acceleration, a starting valve is arranged to admit live steam to the low pressure cylinders and at the same time to permit the high pressure cylinders to exhaust direct to the stack.

Fig. 5 shows this starting valve in diagram form. Fig. 6 shows the general arrangement of the valve motion. A 2 in. pipe is run from the high pressure steam pipe to the low pressure steam chest. The valve in this pipe is operated by an air motor. No special movement is needed to open this valve, but if the throttle lever is pulled all the way open a tappet operates the air valve, which works the starting valve and lets live steam into the low pressure steam chest. At the same time the high pressure exhaust is opened to the stack. If the throttle lever is moved slightly in the closing direction the air valve is released and automatically closes the low pressure live steam valve putting the engine into position for compound working.

The Northern of France made a number of tests of these locomotives with their dynamometer car. It was found that live steam could not be admitted to the low pressure cylinders for more than 10 or 15 seconds without lowering the boiler pressure.

The curves in Fig. 7 show the results of starting tests with normal trains of 220 tons (2,000 lbs.) including engine, live steam being admitted for the first few revolutions only and the engine then being worked compound. These figures may be compared with the Paris Metropolitan engines, which require from 18 to 20 seconds for the first 250 ft. The diagrams of Fig. 7 show that the new engines make the first 250 feet in from 17 to 21 seconds on a level, according as they start with live steam or as a compound. It must be borne in mind, however, that the Metropolitan trains weigh 95 tons empty, or about half the weight of those for the new engines. The Manhattan elevated electric trains run 650 feet in 30 seconds from the start, while in the same time these new Belt engines make 625 feet. It may be added that in ordinary service the engines are started as compounds without using live steam.

The Northern company's Department of Tests took advantage of the trials to figure out the work done by the locomotive when the time allowed for starting was varied. It was important to know what was the cost of gaining a few minutes in a run including a large number of stops such as that of the circuit of Paris. The following figures were obtained. They correspond to:

The original service before being accelerated.

The accelerated service with the new engines.

An ultra-accelerated service using all the power of the new engines.

Several trains were run in these three classes of service. The increase in the power developed is shown in Table 2.

TABLE NO. 2.

	Slow.	Accelerated.	Ultra-accel.
1. Class of service			
2. Effective running time	67 min. 47 sec.	60 min. 27 sec.	52 min. 36 sec.
3. Maximum indicated horse-power	524	637	1,005
4. Speed corresponding to maximum power, m. p. h.	27.6	33.5	36.0
5. Average speed for the circuit of Paris	17.2	19.3	22.1
6. Percentage of speed increase over slow train	....	12.2	28.8
7. Average drawbar pull for the circuit in pounds	4,907	5,664	7,331
8. Percent. of increase of drawbar pull over slow	....	15.4	49.5
9. Total work, at d.-b., during circuit, millions of ft.-lbs.	264	334	463
10. Percentage of increase in work	...	26.5	75.4
11. Work dissipated by brakes during circuit in millions of ft. lbs.	124	174	262
12. Percentage of increase in work of braking	...	40.3	111.5
13. Work of braking in per cent. of total work	47.0	52.0	56.7

The maximum horse-power shown in line 3 is calculated from actual indicator diagrams. The total work in line 9 is found by multiplying the tractive effort by the distance run under steam in making a circuit of Paris. The work dissipated in braking is the sum of the work done in making the 29 stops on one circuit. The work dissipated in stopping is calculated by the formula $\frac{M V^2}{2}$ where M is the mass of the train drawn and V the speed at which the train would have passed the station if the brakes had not been applied.

The figures in the table show that for a gain of 15 minutes in a run of 67 minutes, or say 22 per cent., the drawbar pull of the locomotive is increased 75 per cent.

The figures also show that the new locomotives are capable of developing 1,000 h.p., for a short time at least. Even if we take the nominal horse-power at only 800, the weight of the engine in working order is only 172 lbs. per horse-power, or 143 lbs. for the engine empty.

It is interesting to see how large a percentage of the work produced by the engine is dissipated by the brakes, nearly 57 per cent. of the total power developed on the fastest run has to be thrown away by applying the brakes. The figures show how difficult it is, mechanically speaking, to accelerate a schedule by increasing the speed, and how extremely desirable it would be in a suburban service to have some means of storing up the enormous quantity of work which is destroyed and absolutely lost in the process of braking. In a service as outlined above made up of starts and stops following in rapid succession it is advantageous to keep down the weight of the train as much as possible, and this has been well considered in designing the engines described.

American Railway Association.

The fall meeting of this Association was held at Philadelphia October 26. Mr. C. G. Waldo, Second Vice-President, presided, and about 135 delegates were present. Mr. Geo. A. Post, Chairman of the General Committee on Arrangements for the American Railway Appliance Exhibition, to be given at Washington at the time of the International Railway Congress in May, 1905, stated that it is the desire of the manufacturers to erect a building on a small section of the government reservation, near the Washington monument. To permit this it will be necessary to get leave from Congress. It is hoped that Congress will act favorably, in which event an exhibition will be given which will be of the greatest interest to the delegates, both American and foreign, attending the Congress.

Several amendments to the by-laws were adopted. The Executive Committee reported that the membership now comprises 273 members, operating 217,372 miles, and that the associate membership comprises 10 members, operating 266 miles.

The Association adopted a resolution providing that eight delegates from the Association be accredited to the seventh session of the International Railway Congress; these delegates to be the President and Secretary of the Association, and six other persons to be selected by the President. The Association also voted to increase the membership of the American Section from 26 to 28 members.

The Executive Committee reported that 57 railroads in North America are now members of the Congress, entitled to 327 delegates. These, in addition to the

eight delegates of the American Railway Association and the 16 delegates of the United States Government, will make a total of 351 delegates from America, outside of the official delegates from Canada and Mexico. It was also reported that advice had been received from the Department of State that 18 countries have announced their intention to be represented at the Congress, as follows: Argentine Republic; Belgium; British India; Cuba; Denmark; Dominican Republic; Great Britain; Greece; Guatemala; Honduras; Mexico; Netherlands; Paraguay; Peru; Roumania; Servia, Siam, and the Transvaal.

An addition to Rule 6, of the Code of Per Diem Rules, was adopted, to take effect Jan. 1, 1905, as follows: "In case the road so delivering or authorizing the delivery of a foreign car connects directly with the road which does not pay per diem, penalty shall accrue as if delivery had not been made."

The Committee on Safety Appliances presented a code of rules governing the determination of physical and educational qualifications for those seeking employment and for candidates for promotion, and after a short discussion, at the request of the committee, they were referred back to it for further consideration.

Mr. Theo. Voorhees, First Vice-President of the Philadelphia & Reading, was elected First Vice-President.

The next meeting of the Association will be held in New York City, and as provided in the amendment to the by-laws adopted by the Association, that meeting will be held on Wednesday, April 5, 1905.

The Young Valve and Gear for Locomotives.

For more than three years a new design of locomotive valve mechanism has been quietly undergoing test and perfection on the Chicago & North Western. Its development has been directly under the supervision of its designer, Mr. O. W. Young, of Chicago, whose idea, briefly, is a system of rocking valves—the Corliss principle adapted to locomotive practice. During the period mentioned two North Western locomotives have been equipped with the mechanism, the first being a light American type, and the later one a Class D, Atlantic type passenger locomotive, which has been thoroughly and satisfactorily tested under all conditions, including fast passenger service.

The primary object Mr. Young desired to attain was to produce a valve mechanism that would enable locomotives to attain and maintain higher speeds than are possible with present practice; and to do it not only without sacrifice of economy from present practice, but with improved performance if possible. The accompanying drawings and photograph show pretty clearly the design and arrangement of the valves and gear. There are two valves to each cylinder, similar in form and position to Corliss practice and driven by the Corliss wrist motion through the usual link and rocker. Each valve controls admission and exhaust for its end of the cylinder, and is formed with two openings through its body. One, the larger, is vertical and is for the exhaust. The smaller is transverse and permits freer circulation of the live steam in reaching the lower port, part of the steam passing around the ends of the valve.

The valve has four longitudinal packing strips and an equal number at the ends, the latter being to enclose the exhaust cavity. As mentioned above, the live steam circulates around and through the valve. The packing strips are held outward against the bushing by spring pressure, thereby readily accommodating themselves to any irregularities in the seat. Small rectangular grooves are formed on the inner sides of the longitudinal strips to enable the small amount of steam that will find lodgment there to balance the pressure on the edges opposite and thus permit the strips to move freely in their grooves. This also reduces the bearing surface of the strip against the groove and thereby reduces the liability of its sticking from the presence of gum and foreign substances.

Wrought-iron spindles are pressed into and keyed to the valve body at each end. The valve chest has but one removable head, the other being formed integral with the body, with an opening through which the driving spindle of the valve passes and which forms a bearing for it. There is no provision for packing this spindle in its passage through the end wall of the steam chest. It is given a slight taper and is shouldered at the inner and outer ends of the journal. The joints which these shoulders form with the end wall are ground, and the inner, which is the larger and therefore receives the greater part of the thrust, has five or six grooves cut across it to permit oil from the steam chest to reach the bearing. This provides all of the lubrication that is necessary, and as the taper of the journal is such that in automatically taking up any wear in the bearing no binding will result, the bearing requires no attention whatever between shoppings of the locomotive. No trouble from leakage has been experienced with it.

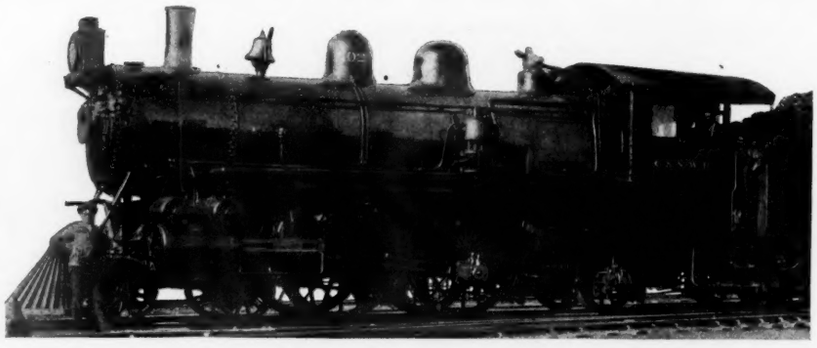
The presence of a shallow groove in each steam chest bushing will be noted. This groove is placed so that the steam strip will overlap it when the valve reaches the extremity of its travel. As the most severe stress is imposed on the valve gear at the time of reversal of motion, by letting live steam under the strip at this point it largely relieves the pressure from above, thereby reducing the stress in the gear and consequently the wear.

The wrist-plate is shown in the details, and also the bearing for it; and in the combination and arrangement of these two is embodied one of the most ingenious and important features of the design, namely, the provision for a variation of the lead to conform to changes in cut-off. As viewed in the drawing the bearing has two horizontal arms supporting the journal on which the wrist-plate moves. The whole piece—the wrist-plate bearing—is supported in bearings, one of which is bolted to the outside of the rear steam chest and the other to the saddle. A downwardly-projecting arm, approximately at right-angles to the others, is connected through a short adjustable rod to a tumbling shaft supported across the back of the saddle, and which in turn is connected by a special reach rod to the main tumbling shaft. This reach rod is pivoted to a short arm fixed rigidly on the latter, and which is horizontal in mid-gear. The end of this arm moves in the arc of a circle, therefore as the tumbling shaft moves it draws this reach rod back slightly and results in raising the center about which the wrist-plate oscillates. This changes the relations of the valves to the ports, thereby affecting the lead.

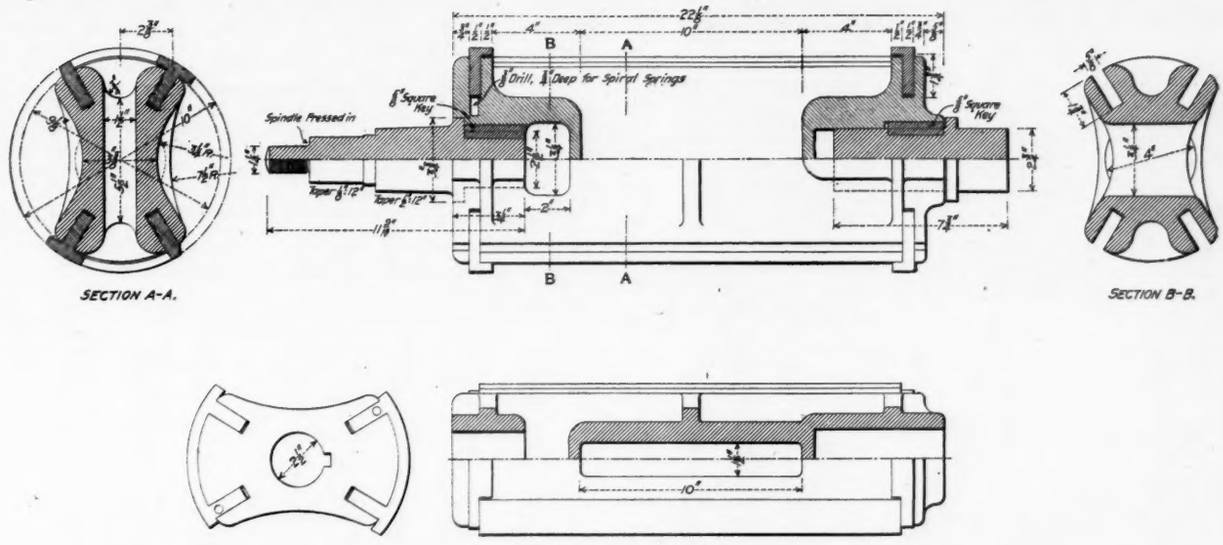
Steam enters the chest through the port just above the middle of the inner side, part passing out through the top port to the passage cored around the bushing leading to the cylinder port; and part passing around and through the valve and out through the port at the bottom of the chest opening directly into the cylinder port. The exhaust passes out into the steam chest through these same ports and escapes through the large port near the bottom. The action of the lead-change mechanism is such that a constant or slightly increased steam lead can be obtained for the shorter cut-offs. The exhaust lead is also increased as the cut-off is shortened, the design being such that a lap at long cut-offs is changed to a clearance at short cut-offs.

A series of indicator cards is shown which were taken in regular service from the locomotive shown in the photograph. This locomotive has 20-in. x 26-in. cylinders, 81-in. drivers, 200 lbs. boiler pressure and a 4¾-in. exhaust nozzle. During the first test the engine had a 10-car train weighing 535 tons, and on the second day four mail cars weighing 200 tons. Cards 1 to 12 were with the heavy train and 13 and 14 with the other. It will be observed that at no time with the heavy train was the throttle fully open, although a speed of 75 m.p.h. was reached. At starting, a five-eighths throttle opening was used. This opening was increased to seven-eighths but shortly reduced to one-half and was never again increased beyond three-quarters. An interesting feature of these cards is the low back pressure, which in some cases, and notably at 55 m.p.h., is zero, and at 63 m.p.h. is only 2 lbs. The data for cards 13 and 14 show the capabilities of the locomotive in the way of speed. The speeds were read from a Boyer recorder and checked by a revolution counter. In all of the cards, even that at 95 m.p.h., the valve events, with the exception of release at the extremely high speeds and the extremely short cut-offs, are readily discernible. The short cut-offs at which some of the cards are taken is notable, card 4 being the shortest, at 2½ in.

Another set of cards shows a comparison between the steam distribution of the Young valve and gear and a Chicago & North Western standard piston valve for this class of locomotive. The data for these cards are found in Table I. Valve motion diagrams are also shown for full-gear and at 25 per cent. cut-off. The principal results are given in Table II. The results especially to be



Chicago & North Western Passenger Locomotive Fitted with the Young Valve and Gear.



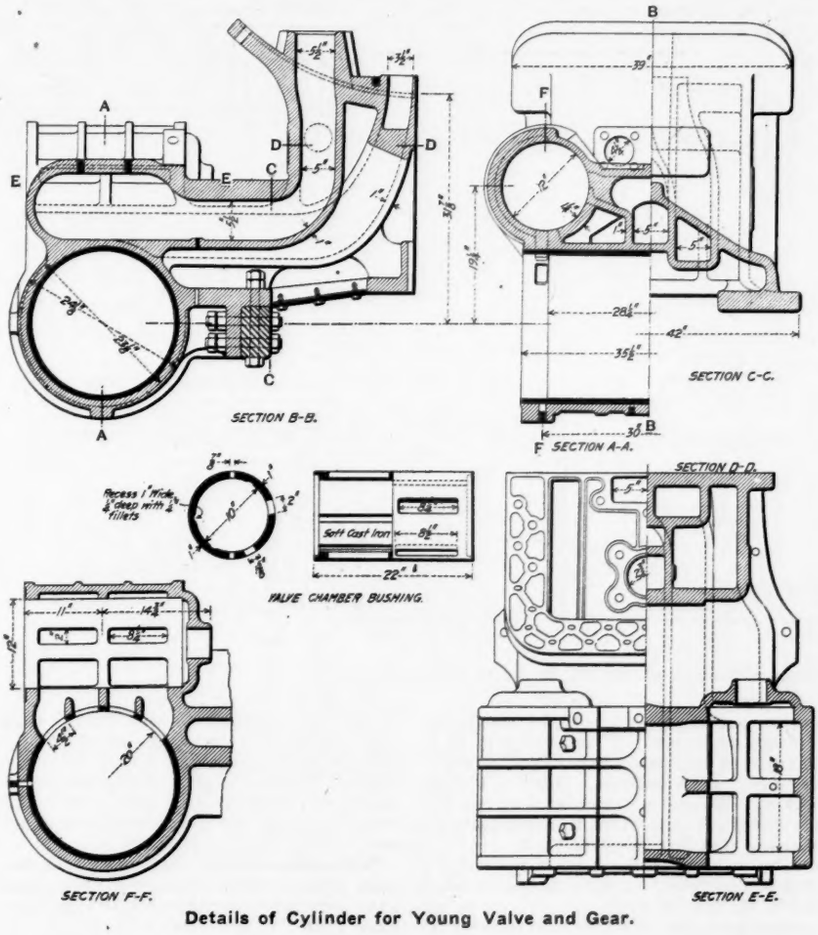
Details of Young Valve.

noted and compared are the exhaust events at 25 per cent. cut-off, particularly the length of time the port is open. The result of the change of exhaust lead of the Young valve for the short cut-off may be noted in the diagram.

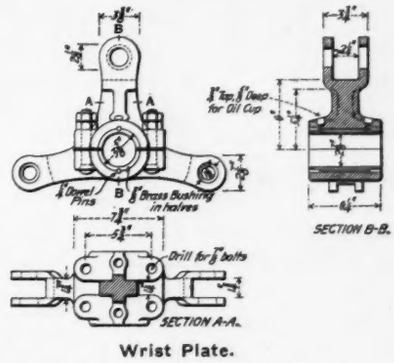
In the matters of performance and maintenance the results have been most gratifying. The locomotive has never lost a trip or made a failure since this mechanism was put on it. So constantly is it kept in service by reason of its excellent performance and uniformly good condition, that last week it had a record of 1,200 miles in 60 hours. In this connection the following, taken from a letter written by Mr. Robert Quayle, Superintendent of Motive Power and Machinery of the Chicago & North Western, is of interest. This letter was made up as a sort of circular reply to the many inquiries that have come from numerous sources, and covers the entire matter briefly. It says:

"The construction of the valves requires a special cylinder casting and therefore they cannot be used without a complete change. The actual cost of these cylinders, including the valves and changes in the motion, should not exceed 30 per cent. more than the cost of cylinders, valves, chests, etc., for a D or piston-valve locomotive. If, however, these cylinders were made standard to a road, I do not think they would cost more than $150 more per locomotive.

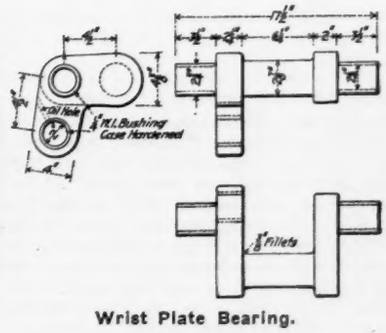
"In June, 1901, the first engine was equipped, and like all first attempts there were certain details shown up which needed improvement. The general results with this engine justified a second trial, and in September, 1903, a set of cylinders with the special valves and their motion were applied to a 20-in. x 26-in. Atlantic type (passenger) engine with 81 in. over the tires and 91,000 lbs. on the drivers. The experiments with this engine lasted some six or eight weeks, and in November, 1903, the engine was put regularly into service on the Galena division. The engine has been a 'tramp' up to a very recent date; has had all kinds of service, all kinds of engineers handling her,



Details of Cylinder for Young Valve and Gear.



Wrist Plate.



Wrist Plate Bearing.

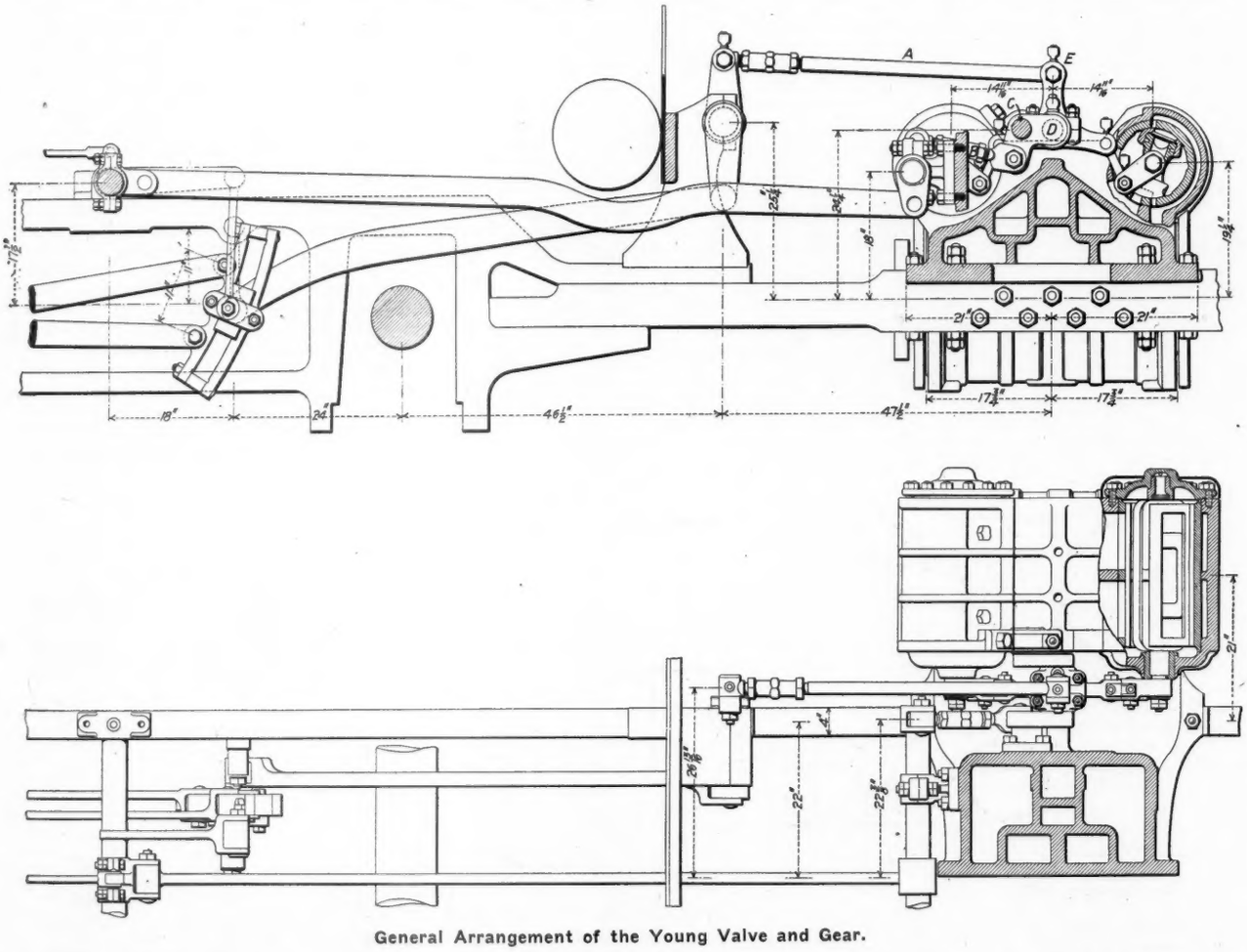
TABLE I.—VALVE EVENTS.

	Slide valve.		Young valve.	
	Full gear.	25 per cent. cut-off.	Full gear.	25 per ct. cut-off.
Steam.				
Lead	—1/16 in.	1/4 in.	—1/16 in.	1/16 in.
Max. port opening occurs	6 1/2 in	3/4 in.	1 1/4 in.	1 1/2 in.
Width of port opening	Full (1 3/4 in.)	1/4 in.	Full (1 in.)	18/32 in.
Port starts to close	14 in.	2 in.	19 in.	2 in.
Port fully closed	21 3/4 in.	6 3/4 in.	22 3/4 in.	6 1/2 in.
Exhaust.				
Port starts to open	— 1 1/2 in.	— 8 1/2 in.	— 1 in.	— 9 1/2 in.
Maximum port opening occurs	3/4 in.	1 in.	0 in.	— 1 in.
Width of port opening	Full (1 3/4 in.)	1 1/2 in.	Full (1 in.)	Full (1 in.)
Port starts to close	20 1/4 in.	4 in.	22 in.	14 1/4 in.
Port fully closed	24 3/4 in.	19 in.	24 7/8 in.	20 1/2 in.

TABLE II.—DATA FROM INDICATOR CARDS SHOWING COMPARISON OF STEAM DISTRIBUTION OF YOUNG VALVE AND GEAR, AND CHICAGO & NORTH WESTERN STANDARD PISTON VALVE.

	Engine No. 1015 with Piston Valve.							*Engine No. 1026 with Young Valve.*							
Card No.	1.	2.	3.	4.	5.	Total.	Average.	1.	2.	3.	4.	5.	Total.	Average.	Per ct. of gain.*
Revolutions per minute	138	180	186	242	336	1,082	216	120	168	204	264	312	1,068	214	....
Miles per hour	32	42	43	58	78	253	50.6	29	40	49	63	75	256	51.2	....
Inches of cut-off	5 1/2	5 1/2	7 1/2	6 1/2	7 1/2	32.5	6.5	5 1/2	3 1/2	6 1/2	4 1/2	5 1/2	25.5	5.1	....
Initial pressure	178	162	150	160	150	800	160	132	162	155	158	150	787	157	....
Pressure at cut-off	118	120	95	96	92	521	104	134	142	136	128	125	665	133	....
Difference between initial, and cut-off pressures	60	42	55	64	58	279	56	28	20	19	30	25	122	24	57%
Pressure at release	40	40	41	37	43	201	40	39	33	55	33	50	210	42	....
Initial back pressure	3	5	6	8	15	37	7.4	0	0	8	2	8	18	3.6	51%
Mean back pressure	18	21	20	22	33	114	22.8	4	10	14	16	24	68	13.6	40%
Mean effective pressure	50	46	42	38	33	209	41.8	69	53	72	48	50	292	58.4	40%
Indicated horse-power	144	171	164	191	231	901	180	166	178	293	256	316	1,209	242	34%
Pounds of steam per hour per I. H.-P.: At cut-off	15.8	17.7	19.8	21.9	24	99.2	19.8	15.4	13.2	16.9	14.4	19.5	79.4	15.9	25%
Pounds of steam per hour per I. H.-P.: At release	22.3	24.4	21	24.3	27.6	119.6	23.9	14.6	15.5	17.7	16.5	22.4	86.4	17.3	28%

*For engine 1026.

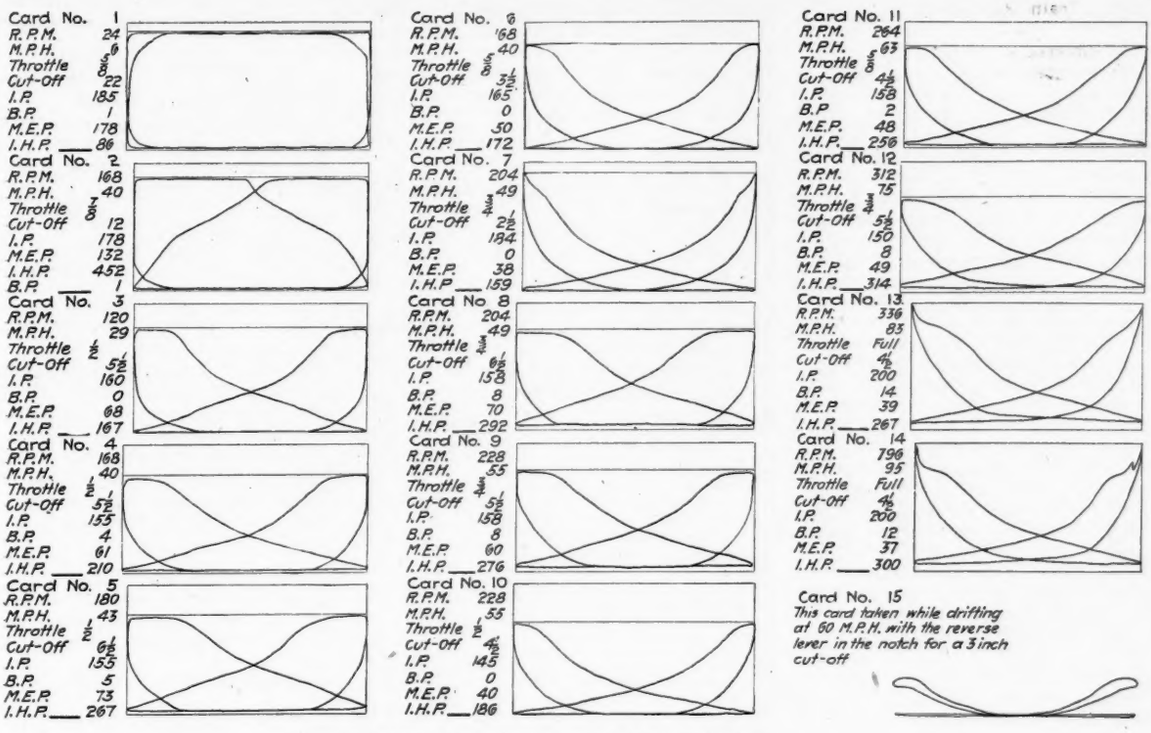


General Arrangement of the Young Valve and Gear.

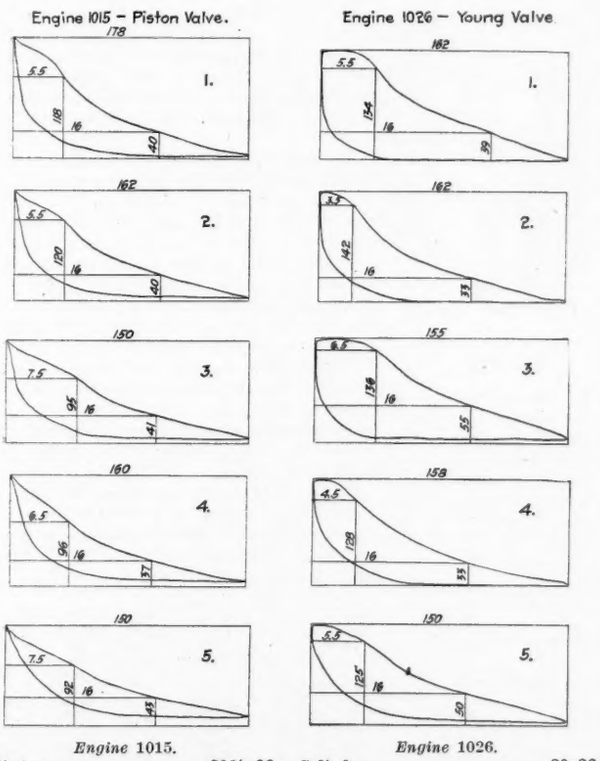
and practically continuous service. It has so far made approximately 90,000 miles. The tires have not been turned, the eccentric straps have been closed once about 1/16 in. each, there is no pound in the boxes and the tool marks are still on the motion pins. These results are especially interesting to the motive power official, demonstrating as they do that the wear and tear on the machinery is so remarkably less than the engine with the D or piston valves. The engine is always ready for service, the roundhouse foreman reporting that for his part of it, five of this type would easily equal seven of the piston valve engines. There is one run between Chicago and Clinton with usually ten heavy cars on which this engine is the *only one* that can make the time.

"The train despatchers know the value of this engine, also, as they do not hesitate to rely on it to make up time or take an unusually heavy run. As a consequence the improvements shown by the indicator cards are not entirely realized in actual performance records. In a series of comparisons made by the indicator the water rate per indicated horse-power was reduced from 22.9 lbs. to 19.3 lbs. The indicator cards also show the cause for the slight wear on the machinery, as the cards are remarkably full, the expansion lines being clear and distinct at all points of cut-off. Most of the work in passenger service is done at less than 6 in. cut-off. On account of the high and full cards it is evident that the crank effort is more uniform and higher than with a slide-valve engine. Besides causing less wear on the machinery, this gives a more even torque when starting and consequently less slipping.

"The engine is one which will bear thorough investigation. While our experiments have been made in passenger service, I consider that the performance in freight ser-



Indicator Diagrams—Young Valve and Gear.



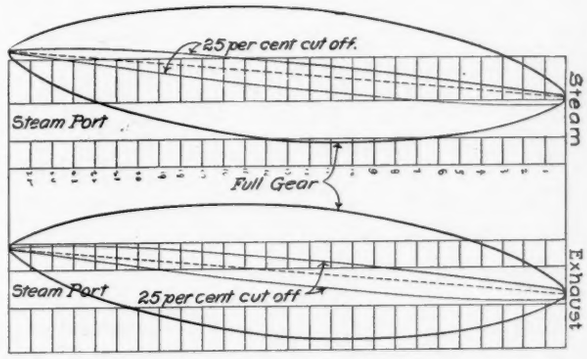
Engine 1015.

Cylinders	20⅛x26
Clearance	5½ *per cent.*
Boiler pressure	200 *lbs.*
Nozzle	4¾ *in.*
Drivers	78 *in.*

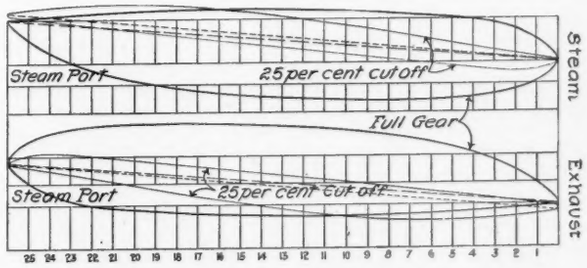
Engine 1026.

Cylinders	20x26
Clearance	6 *per cent.*
Boiler pressure	200 *lbs.*
Nozzle	4¾ *in.*
Drivers	81 *in.*

Comparison of Steam Distribution of Young Valve and Gear and C. & N. W. Standard Piston Valve.



Link and Slide Valve Motion.



Young Oscillating Valve Motion.

Comparative Valve Gear Diagrams.

vice will show even better results from both an operating and economical standpoint."

It is but fair to add that the application to the 1,026 is only the second, and the results obtained with it suggest to the designer a number of points wherein he expects further to improve and perfect the mechanism and thereby increase its efficiency.

There is a general outcry, and has been for some months, in Belgium against the irregularity of the train service; the newspapers are full of complaints, including partisan attacks against the responsible minister. It is evident that passenger traffic has grown altogether out of proportion to station and yard accommodations. Recently on the arrival of a train in Liége from Brussels all the passengers gave three cheers, formed a procession, carried the conductor in triumph at its head, marched to the engine and presented the engineman with a bouquet, after which a congratulatory telegram was sent to the Railroad Minister. Some one inquiring what all this meant, he was answered that it was because at last a Brussels train had got in on time!

Train Resistance.

BY CHESTER A. CRANDELL, M.E.

For the purposes of this article, train resistance will be defined as the number of pounds of drawbar-pull exerted in moving one ton of train weight under the specified conditions. Train resistance, thus defined, is dependent for its value upon a number of variables. The greatest accuracy must, therefore, be observed in its calculation, so-called approximations being seldom anything but misleading. The discussion of this subject will be separated into three divisions. First, a comparison of the calculated with the actual train resistance will be made. Second, an analysis of the several factors which influence train resistance will be presented, together with a comparison of the magnitudes of their influences. Third, the best-known formulæ will be compared with each other. The first two heads will be subdivided to consider separately passenger and freight trains.

Actual and Calculated Train Resistance Compared.—For the purposes of this comparison, the results of two locomotive trials have been plotted. One of these trials was made with a passenger and the other with a freight train; both being conducted under what are considered to be representative conditions.

Passenger Train.—Fig. 1 was plotted from the results given by a passenger train consisting of 11 cars weighing in all 377.23 tons. Two curves are shown, the one marked "Drawbar Pull" being referred to the ordinates whose scale appears at the left of the figure. The other curve, marked "Velocity," is referred to the right-hand scale. The various conditions of grade and curvature are noted on the figure. In order to avoid the errors incident to the changing of scales, the ordinates of both curves are the actual lengths taken from the dynamometer record.

Table 1.

Seconds, from start.	Velocity in m. p. h.	Acceleration, ft. pr sec, per sec.	Seconds, from start.	Velocity in m. p. h.	Acceleration, ft. pr sec, per sec.
0	0.0	0.0			
10	3.64	0.50	160	40.91	0.24
20	7.28	.50	170	42.20	.10
30	10.90	.50	180	43.30	.18
40	14.10	.50	190	44.50	.16
50	17.60	.40	200	45.30	.18
60	20.00	.34	210	46.50	.20
70	22.70	.34	220	47.70	.18
80	25.00	.34	230	48.64	.12
90	27.70	.34	240	49.35	.12
100	30.00	.30	250	49.73	.04
110	31.59	.26	260	50.20	.08
120	33.60	.24	270	50.45	.08
130	35.90	.28	280	50.91	.04
140	37.90	.26	290	51.58	.08
150	39.15	.28	300	52.27	.12

The accelerations as calculated from the inclination of the velocity curve (Fig. 1) are given in Table 1, and shown graphically in Fig. 2.

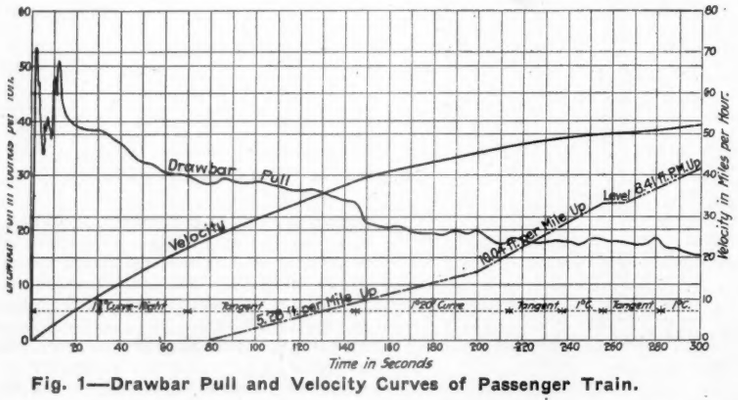


Fig. 1—Drawbar Pull and Velocity Curves of Passenger Train.

All the necessary data being now at hand, a basis upon which to compare the theoretical with the actual results must be decided upon. It is obivous that to reduce the actual conditions to those on a level tangent would be to destroy their value as data. Therefore the conditions for the theoretical calculations will be assumed to be the same as those existing in the actual case.

Let R_t = Total train resistance in lbs. per (2,000 lb.) ton.

Let R_a = Train resistance due to acceleration in lbs. per ton.

Let R_v = Train resistance due to velocity in lbs. per ton.

Let R_g = Train resistance due to grade in lbs. per ton.

Let R_c = Train resistance due to curvature in lbs. per ton.

Let v = Velocity in miles per hour.

Let a = Acceleration in ft per sec., per sec.

Let T = Weight of train in (2,000 lb.) tons.

Then $R_t = R_v + R_a + R_g + R_c$.....[1]

Using Sprague's formula:

$$R_v = 4 + \frac{v}{6} + \frac{v^2}{3T} \text{.....[2]}$$

gives the results found in column headed R_v, Table 2.

Table 2.

Seconds from start.	Lbs. per ton. Sprague's formula, R_v.	R_a.	R_g.	R_c.	R_t.
0	4.00	0.0	0.0	0.875	4.00
10	4.62	31.08	0.0	0.875	36.58
20	5.26	31.08	0.0	.875	37.22
30	5.93	31.08	0.0	.875	37.84
40	6.53	31.08	0.0	.875	38.49
50	7.20	25.86	0.0	.875	33.94
60	7.68	21.12	0.0	.875	29.68
70	8.23	21.12	0.0	.875	30.93
80	8.72	21.12	2.1	0.0	29.84
90	9.30	21.12	2.1	0.0	32.52
100	9.80	18.61	2.1	0.0	30.51
110	10.09	16.15	2.1	0.0	28.34
120	10.59	14.90	2.1	0.0	27.59
130	11.13	17.40	2.1	0.0	30.63
140	11.47	16.15	2.1	0.0	29.72
150	11.87	17.40	2.1	.665	32.04
160	12.30	14.90	2.1	.665	29.97
170	12.67	6.22	2.1	.665	21.66
180	12.89	11.37	2.1	.665	27.03
190	12.95	9.94	2.1	.665	25.66
200	13.37	11.37	3.803	.665	27.51
210	13.66	12.40	3.803	.665	30.53
220	13.96	11.37	3.803	0.0	29.13
230	14.19	7.45	3.803	0.0	25.44
240	14.36	7.45	3.803	.500	26.11
250	14.46	2.48	3.803	.500	17.44
260	14.59	4.96	0.0	0.0	19.55
270	14.67	4.96	3.186	0.0	22.82
280	14.77	2.48	3.186	0.0	20.44
290	14.95	4.96	3.186	.500	23.60
300	15.11	7.45	3.186	.500	26.25

R_a must now be found. This may be calculated as follows:

We know that

$$F = ma \text{.....[3]}$$

or the force exerted upon the drawbar of a train will be equal to the mass of the train multiplied by the acceleration produced.

Obviously this force is exerted only because there is a resistance to acceleration due to the inertia in the mass of the train. Therefore, the resistance being measured by the force required to overcome it, may be substituted for "F" in equation [3] or

$$R_a = ma$$

As R_a is measured in pounds per ton, $m = \frac{2,000}{32.2}$

$$\text{Therefore } R_a = \frac{2,000}{32.2} a$$

or $R_a = 62.1\ a$, at any instant.....[4]

The results given by equation [4] are tabulated in the column headed R_a, Table 2.

The resistance due to an up grade of one foot per mile is obviously

$$\frac{1}{5,280} \times \text{Weight}$$

or $R_g = \frac{1}{5,280} \times 2,000 \times$ (number of feet per mile rise).

Solving $R_g = .3788$ (number of feet per mile rise).....[5]

The results of calculation by equation [5] are given in the column headed R_g, Table 2.

For the resistance due to curves, Mr. George R. Henderson gives:

$R_c = 0.5$ (number of degrees of curve).

The results of these calculations are given in the column headed R_c, Table 2.

Now (equation [1]) we have

$$R_t = R_v + R_a + R_g + R_c$$

Therefore, adding the results in the previous columns of Table 2, gives the values in the last column, R_t, which are plotted in Fig. 3, and compared with the actual drawbar-pull curve from Fig. 1.

A glance at Fig. 3 shows immediately that the heavy pull in starting a train due to its inertia is not recognized in the formula. Indeed, no account is taken of this element, which may be called starting resistance, in any of the formulæ which have come to the author's attention, with the exception of that proposed by *Engineering News*. That it is of the greatest importance is at once evident, since, for all ordinary track conditions, this starting resistance measures the maximum pull which the locomotive will be called upon to exert.

A familiar method of overcoming some of the effects of this starting resistance is the common practice of "taking slack." In theory, this brings the starting resistances of the several cars to different points on the coördinate axis of time and thus distributes the instants of maximum drawbar-pull. That is, by the time the starting resistance comes into play on the last cars, the resistance of the first cars has dropped to a normal value.

Freight Trains.—In the case of freight trains where the ratio of the weight to the number of cars becomes much smaller than in passenger trains, the train resistance formulæ give results which differ widely from the actual values.

Fig. 4 presents the actual curves from the dynamometer record of a freight train trial. It is analogous to Fig. 1, and shows the velocities and drawbar-pulls of a 91 car freight train weighing 1,015 tons.

Table 3.

Seconds, from start.	Velocity in m. p. h.	Acceleration, ft. pr sec, per sec.	Seconds, from start.	Velocity in m. p. h.	Acceleration, ft. pr sec, per sec.
0	0.0	0.0	160	14.34	0.0265
10	1.75	.1192	170	14.71	.0260
20	3.31	.1063	180	14.90	.0140
30	4.58	.0865	190	15.10	.0140
40	5.85	.0860	200	15.40	.0200
50	7.22	.0930	210	15.50	.0060
60	8.30	.0530	220	15.60	.0060
70	9.25	.0660	230	15.60	0.0
80	9.85	.0400	240	15.60	0.0
90	10.55	.0470	250	15.60	0.0
100	11.15	.0400	260	15.70	.0070
110	11.70	.0390	270	15.80	.0070
120	12.30	.0400	280	15.80	0.0
130	12.88	.0400	290	15.80	0.0
140	13.45	.0395	300	15.88	.0050
150	13.95	.0330			

Table 3 gives the accelerations as calculated from the inclination of the velocity curve in Fig. 4, these accelerations being plotted in Fig. 5.

Fig. 6, which is analogous to Fig. 3, gives very strikingly the great error in the the-

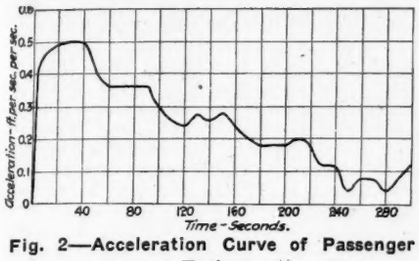


Fig. 2—Acceleration Curve of Passenger Train.

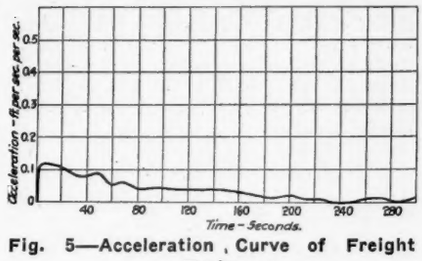


Fig. 5—Acceleration Curve of Freight Train.

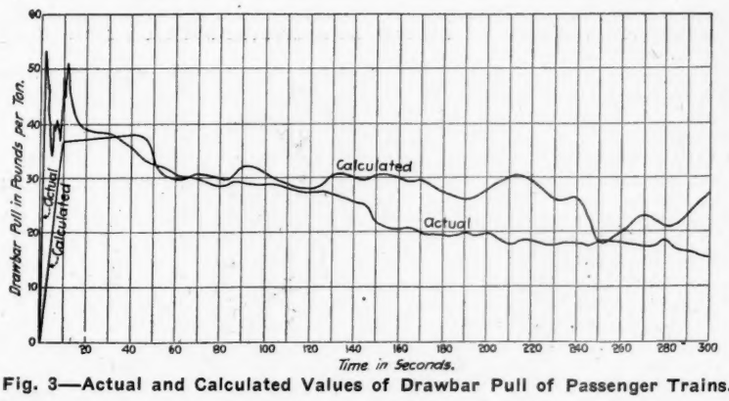


Fig. 3—Actual and Calculated Values of Drawbar Pull of Passenger Trains.

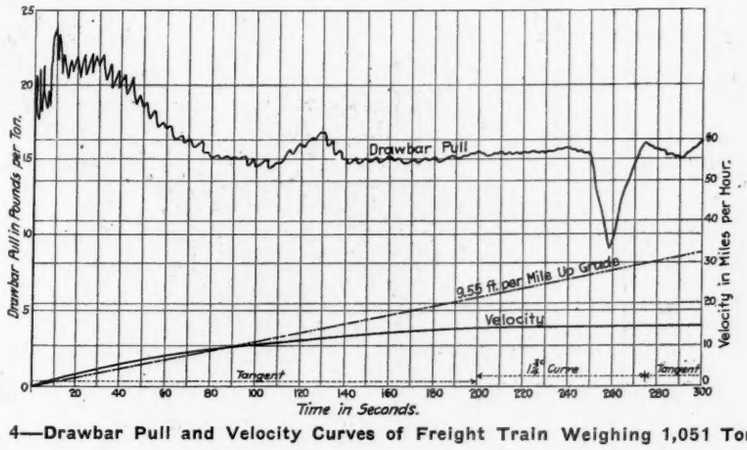


Fig. 4—Drawbar Pull and Velocity Curves of Freight Train Weighing 1,051 Tons.

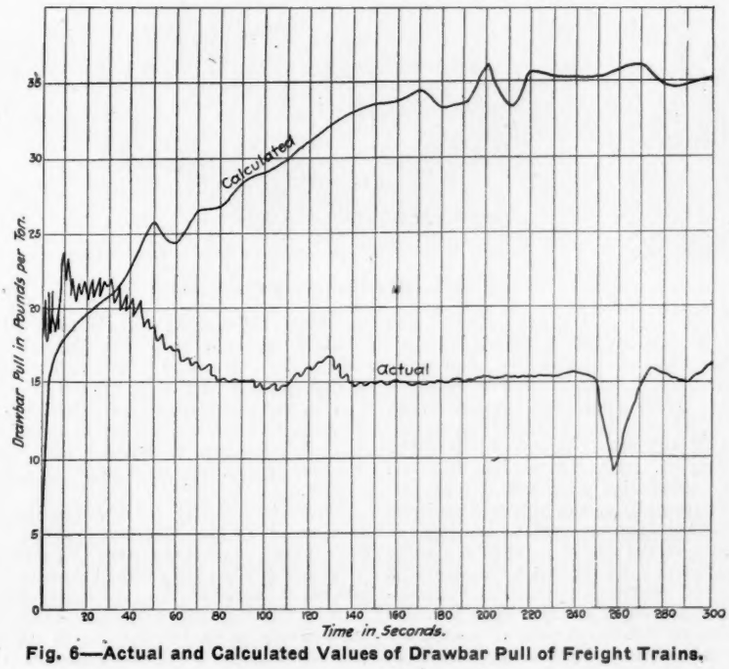


Fig. 6—Actual and Calculated Values of Drawbar Pull of Freight Trains.

oretical resistance as applied to freight trains.

The curve marked "calculated" is plotted from the values of R_t, Table 4, as given by using Sprague's formula for R_v; while the curve marked "actual" is the drawbar-pull curve of Fig. 4.

Table 4.

Seconds from start.	Lbs. per ton. Sprague's formula, R_v.	R_a.	R_g.	R_c.	R_t.
0	4.00	0.0	3.62	0.0	7.62
10	6.92	7.41	3.62	0.0	17.99
20	9.55	6.62	3.62	0.0	19.85
30	11.75	5.37	3.62	0.0	20.74
40	13.86	5.34	3.62	0.0	22.82
50	16.27	5.77	3.62	0.0	25.66
60	17.58	3.29	3.62	0.0	24.49
70	18.70	4.10	3.62	0.0	26.42
80	20.74	2.48	3.62	0.0	26.84
90	21.96	2.92	3.62	0.0	28.50
100	23.01	2.48	3.62	0.0	29.11
110	23.95	2.42	3.62	0.0	29.99
120	25.10	2.48	3.62	0.0	31.20
130	26.04	2.48	3.62	0.0	32.14
140	26.99	2.45	3.62	0.0	33.06
150	27.94	2.05	3.62	0.0	33.61
160	28.57	1.645	3.62	0.0	33.84
170	29.21	1.615	3.62	0.0	34.45
180	29.58	0.869	3.62	0.0	33.29
190	29.95	0.869	3.62	0.0	33.66
200	30.43	1.240	3.62	.875	36.17
210	30.61	0.373	3.62	.875	35.48
220	30.80	0.373	3.62	.875	35.67
230	30.80	0.0	3.62	.875	35.30
240	30.80	0.0	3.62	.875	35.30
250	30.80	0.0	3.62	.875	35.30
260	30.99	0.435	3.62	.875	35.93
270	31.20	0.435	3.62	.875	36.14
280	31.20	0.0	3.62	0.0	34.82
290	31.20	0.0	3.62	0.0	34.82
300	31.33	0.310	3.62	0.0	35.26

Analysis of Theoretical Train Resistance.—In considering the comparative influences of the several factors in train resistance, the subject will again be subdivided to afford a separate consideration of passenger and freight trains.

Passenger Trains.—The curves of Fig. 7 were plotted from the results of Table 2, and serve to show the comparative magnitudes of the several influencing elements. The most notable feature of this figure is the great influence of the acceleration resistance, R_a.

The previous treatment of this subject, which has been confined chiefly to the velocity resistance, R_v, has left the impression that velocity is the controlling factor. Fig. 7, however, serves to show that it is to the acceleration rather than to any instantaneous

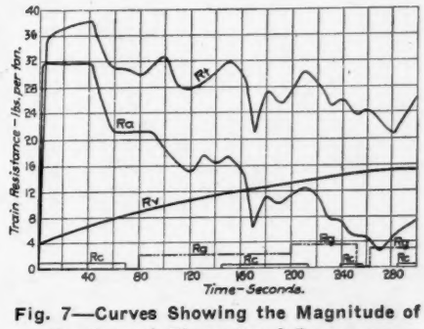


Fig. 7—Curves Showing the Magnitude of the Several Elements of Passenger Train Resistance.

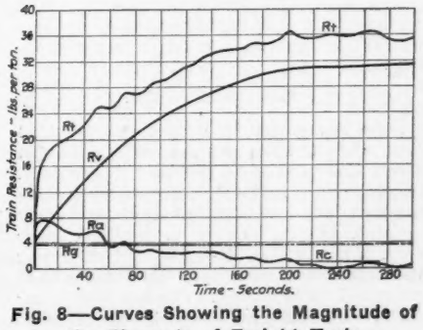


Fig. 8—Curves Showing the Magnitude of the Elements of Freight Train Resistance.

value of the velocity that the curve R_t chiefly owes its characteristics.

Owing to the difficulty of properly measuring or calculating the acceleration, and to the misconception which has prevailed as to the magnitude of its influence, this important factor in the case of passenger trains has been frequently neglected in computations. It needs but a glance at the respective velocity curves of Figs. 1 and 4 to show that it is largely the difference in accelerations which causes so wide a discrepancy in the drawbar-pull lines of these figures.

Freight Trains.—In the case of freight trains where the acceleration is small, the velocity resistance, R_v chiefly influences the value of R_t, as is shown in Fig. 8. R_a, which is so important a factor in passenger train resistance, becomes here of lesser importance.

In summing up, it may be said that the starting resistance, which is neglected in most of the formulæ, should be considered; and that it may safely be taken as varying inversely with the length of the train from 1½ to 2 times the average total resistance. The acceleration resistance, R_a, is in the case of passenger trains, the most important factor, and should in no case be omitted. In the case of freight trains, R_v is the determining factor, but the present formulæ give results so erroneous as to be rather misleading than useful.

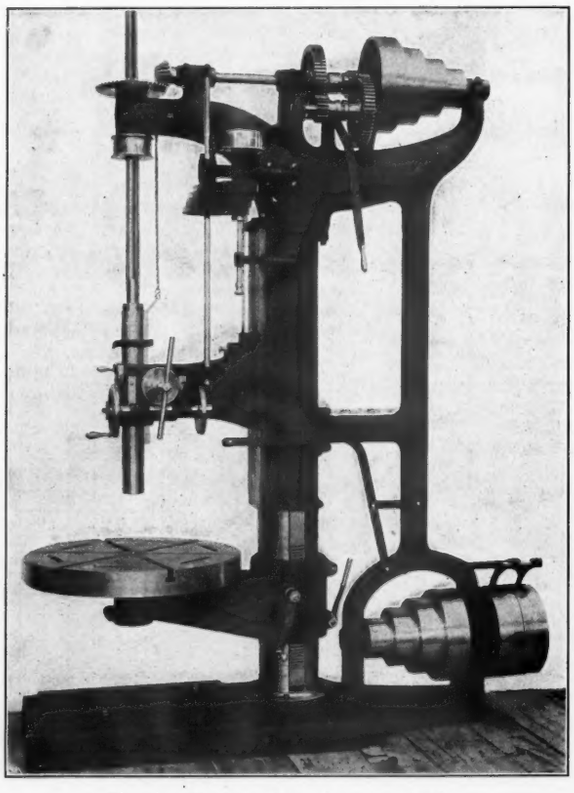


Fig. 1—The Hamilton Upright Drill.

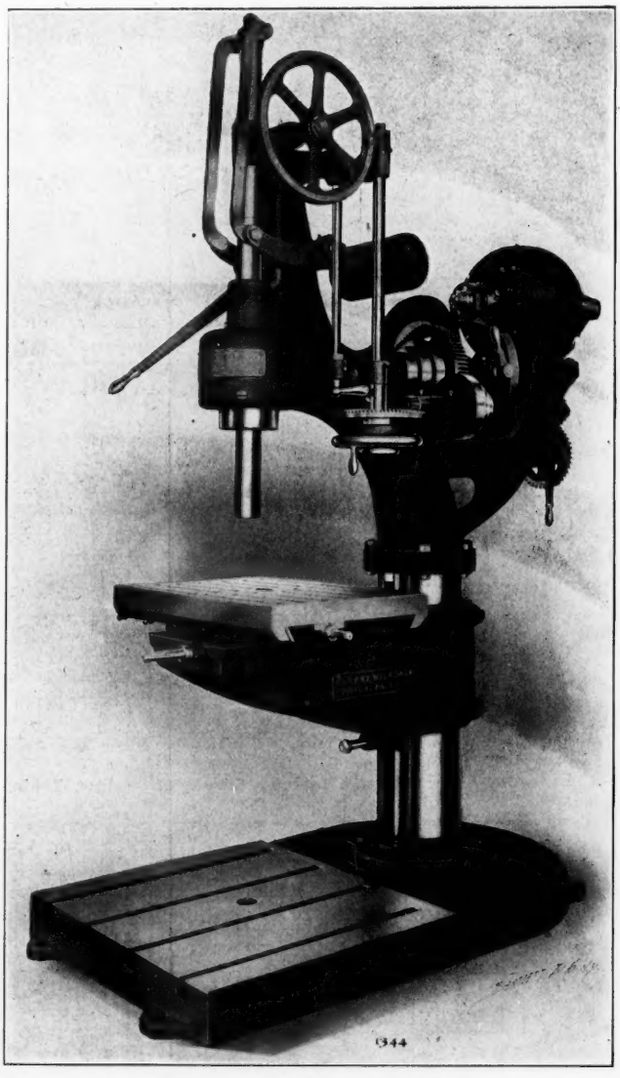


Fig. 2—Niles-Bement-Pond Upright Drill.

By a law passed in 1903 it was provided that when the net earnings of the Danish State Railroads should exceed 2 per cent. on the capital invested, a certain proportion of such net earnings, varying with their amount, but in no case to exceed 0.6 per cent. of the capital, should be divided among the employees, who were divided for that purpose into 14 classes. The first fiscal year under this law gave to the lowest grade of employees $15 each as their share of the profits; firemen received $23.28; enginemen $31; station-masters, $40.90; the highest grades of officers, $286.75. The net earnings were 4 per cent. on the capital, which is much more than heretofore, though the interest of the employees in the profits is credited with only a part of the improvement.

Railroad Shop Tools.

(Continued.)

UPRIGHT DRILLS.

The 42-in. upright drill press Fig. 1 is made by the Hamilton Machine Tool Company, Hamilton, Ohio. The base of this machine is heavily ribbed and is provided with large I slots. The column is 10½ in. in diameter and it is bolted to the bed and supported by a lock brace as shown. The sliding head has a travel of 31 in. and it is counterbalanced and has a long bearing on the column. It can be locked in any desired position by bolts and is raised and lowered by means of a rack and pinion. The smallest diameter of the spindle is $2^{9}/_{16}$ in. It is counterbalanced and has both hand and power feeds. The spindle has eight changes of speeds and is provided with three changes of power feed for each speed. It has a traverse of 16 in. and is provided with quick approach and return movement, by means of a rack and pinion. Ball bearings are used to take up the end thrust of the spindle. The lock gears are engaged and disengaged by means of a lever placed within easy reach of the operator. The top shaft runs in split bearings lined with babbitt metal. Power feed is obtained by two cones of gears and changes in feed can be made while the machine is in motion by shifting the sliding shaft or pull pin which is placed just beneath the gears, as shown in the illustration. The friction mechanism is operated from the front of the machine by means of a nut. An automatic stop is provided which can be set to any desired depth by the graduations on the spindle sleeve. The table arm has a vertical adjustment of 17 in. and can be swung around to clear the base. It is raised and lowered by means of a rack and pinion in connection with a worm gearing, which is encased within the table arm. The table can be revolved in its socket. The table is 36 in. in diameter and has T slots. The greatest distance from the spindle to the table is 43 in. and the maximum distance from the spindle to the base is 59 in. The height of the machine to the top of the cone is 9 ft. 8 in. and the floor space required is 92 in. x 90 in., and the net weight is about 4,500 lbs. Friction geared tapping attachments can be applied to these machines when desired.

The 50 in. vertical drilling machine, Fig. 2, is made by the Niles-Bement-Pond Company, New York. It was designed especially for heavy drilling and railroad shop use. The maximum distance from the column to the center of the spindle is 25 in. and the greatest distance from the spindle to the base plate is 58 in. A maximum distance of 31½ in. is allowed for, between the top of the

table and the spindle. An 18-in. traverse is provided for the spindle. The spindle is 3⅝ in. in diameter and is counterbalanced and has three changes of power feed and a rapid hand motion. The table is 26 in. x 36 in. and is provided with both longitudinal and horizontal adjustments. It is also provided with vertical power adjustment and it can be swung around the column and out of the way when it is desired to use the base plate for drilling. The 2½ h.p. motor for driving this drill has a speed range from 350 to 1,750 r.p.m. by field control, and in combination with the changes by gears, the spindle speeds range from 8½ to 220 r.p.m. The motor as applied to the rear of this machine gives it a very pleasing and symmetrical appearance. When belt driven the machine is furnished with countershaft-pulleys 16 in. in diameter for a 3½ in. belt, and they should run at 160 r.p.m.

The latest design of electrically driven upright drilling and tapping machine made by

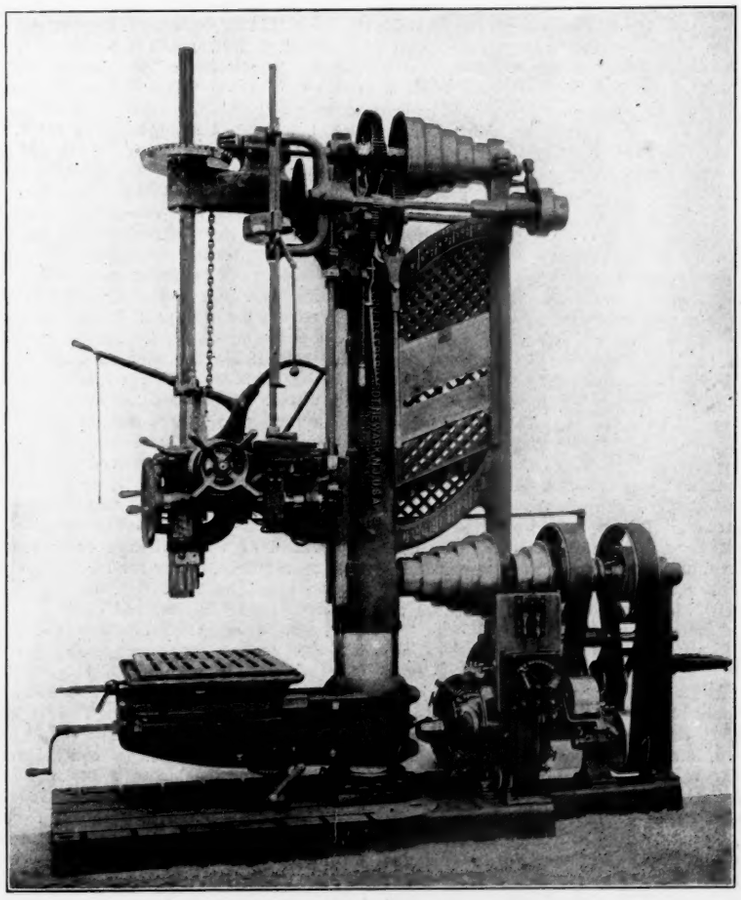


Fig. 3—Gould & Eberhardt Upright Drill.

Gould & Eberhardt, Newark, N. J., is shown in Fig. 3. This machine has two spindles, one for drilling and one for tapping. The near spindle in the illustration is for drilling. After a piece is drilled, the work is shifted by means of the compound traverse table, to bring it into line with the tapping spindle. Holes up to 1½ in. can be tapped with this machine. The ingenious Gould & Eberhardt system of speed indicators for the cone pulley belt is used, as shown in the illustration. The set of figures on the lower brace indicates the position of the belt for such sizes of drills as do not require the back gears. The figures on the upper brace are for use with the back gears. The back gears are operated by a single movement of a lever and the feed is driven by its own belt, and is thus independent of the drill spindle speed. Variable feed is obtained by two friction disks and an index on the adjusting rod shows the settings to give the proper feed for the different sizes of drills. Automatic and hand feeds operating in either direction are fitted to both the quill and the drilling head. A novel arrangement of electric drive is used. Both belts are open but one of them is made to operate the reverse motion for withdrawing the tap. This is accomplished by a pair of gears which connect the armature shaft with the driving pulley shaft, and so reverse the motion of the latter. A pair of friction clutches operated by a rod enable the operator to engage either motion as desired. To compensate for wear, the spindle is fitted with double conical bearings in the quill. The quill is square externally, as the clamping surface of a square quill is considered to be effective and to give great rigidity in boring deep, rough holes. In addition to the compound traverse table shown, a portable compound chuck is sometimes furnished, by which the machine is made available for use as a profiling machine. It is also largely used for end and side milling, the power of the machine being sufficient, and its stability and rigidity ample for certain work of this nature. This machine is made in 25, 32, 27, 43, 48 and 52 in. sizes.

(To be continued.)

Russia appears to be relapsing into barbarism—that kind of barbarism which exists in the United States. A recent press despatch says that attempts at train wrecking in Russia average one in three days and that 11 per cent. of these attempts result in damage.

Concrete and Concrete-Steel.*

The writer can see no good reason why concrete-steel bridges with spans of 500 ft., or more, cannot be built with perfect safety and often with economy; he has designed and submitted bids on spans as great as 300 ft., and although the plans and prices were satisfactory, other and weightier considerations, from the point of view taken by the officials, induced them to prefer steel structures. It is unfortunate from an engineering standpoint that very few bridge sites are located so as to make long spans economical, or even possible, and in most cases, to meet the conditions of grade and high water, it is necessary to have comparatively short spans with minimum rise of arches. A considerable contraction of waterway by piers, or approaches, is not such a serious matter as many imagine, as the water between the obstructions will about make up in velocity what it lacks in area. At Topeka, Kan., the waterway was contracted from 850 to 540 ft., or 36.5 per cent., with no serious consequences until the unprecedented high water of 1903, when about 160 ft. of earth-fill on the north end went out, because the grade was so low that the water overflowed the bank and washed it out, but the water kept on rising notwithstanding, and reached its maximum stage after the embankment disappeared.

Concrete-steel bridges are rapidly gaining in favor. They cost more than light iron bridges with plank floors, but in many localities they will cost no more, and frequently less, than good steel bridges carrying a pavement. The advantages of a concrete-steel bridge as compared with a concrete bridge are not due so much to diminished sections or cost as to the greatly increased security which the steel affords in providing against settlements or other conditions which cannot be calculated or foreseen. Under normal conditions the steel is not strained to much more than one-quarter of its elastic limit, so that a very large reserve force is always available for emergencies. The claimed and generally recognized advantages of a concrete-steel bridge, as compared with a steel bridge, are as follows: They make handsomer structures, and architectural ornamentation can be applied to any extent desired; if properly designed and constructed, they have vastly greater durability and greater ultimate economy; they are comparatively free from vibration and noise; they are proof against tornadoes and fire, and also against floods, if the foundations are protected from scour; the cost of maintenance is confined to the pavements; home labor and home material are utilized to a much greater extent in building them, so that the greater part of the money which they cost is left among the people who pay for them.

Fire Protection.—It has been quite well established by several large fires, as well as by comparative tests, that concrete and concrete-steel are superior to hollow tile for resisting intense heat. Comparative tests of a hollow, hard, tile arch and a Roebling concrete arch, made Nov. 19, 1897, in New York city, resulted in the collapse of the tile arch in 3 hr. 16 min. after the fire was started and when 2,300 deg. Fahr. had been reached. The concrete arch was not damaged. A fire in Pittsburg, Pa., May 3, 1907, destroyed Horne & Company's store having fireproofing of hard clay tile, and the Horne office building with fireproofing of porous terra cotta, but the concrete-steel floor arches of the Methodist Book Building were

*Abstract of a paper by Edwin Thacher, M. Am. Soc. C. E., presented before the International Engineering Congress, St. Louis, October, 1904.

denuded of plaster, otherwise only slightly damaged.

Protection of Steel in Concrete.—Will concrete protect from oxidation iron or steel embedded therein? This is an important question, for, if not, concrete-steel construction will deteriorate, and in time fail, and as all engineers at least are not fully satisfied on this subject, such testimony as the writer has been able to collect will be of interest.

Spencer B. Newberry, Assoc. M. Am. Soc. C. E., mentions a concrete-steel water main, on the Monier system, at Grenoble, France, 12 in. diameter, 1 ft. 6 in. thick, containing steel framework of ¼ in. and $^1/_{16}$ in. steel rods, taken up after 15 years' use in damp ground. The adhesion was found perfect and the metal absolutely free from rust. He also mentions a concrete-metal retaining wall in Berlin which was examined after 11 years' use and the metal found free from corrosion, except in some cases where the rods were within 0.3 or 0.4 in. from the surface. Professor Newberry explains how the effect of concrete in preserving metal is not due to the exclusion of air, and even though the concrete be porous and not in contact with the metal at all points, it will still filter out and neutralize the carbonic acid and prevent corrosion.

G. Bouscaren, M. Am. Soc. C. E., removed, in 1875, several links from the anchorage of a suspension bridge partly built by Roebling in 1855, and they were found to be in a perfect state of preservation.

L. L. Buck, M. Am. Soc. C. E., states that he found rust on the anchorage of the Niagara Suspension Bridge where limestone was in contact with the metal, but where limestone was not in contact, and no movement had taken place, the metal was found in perfect condition after 25 years.

E. L. Ransome, Assoc. Am. Soc. C. E., saw, in Chicago, Ill., workmen breaking up slabs of limestone concrete which had covered sidewalk vaults for eight or ten years. The slabs had iron rods embedded which were rust free.

William Sooy Smith, M. Am. Soc. C. E., speaks of a small piece of iron set in mortar taken from the base of the obelisk in Central Park, New York city, which was bright after 2,300 years; he also says that in removing a bed of concrete at a lighthouse in the Straits of Mackinac, 20 years after it was laid, and 10 ft. below water surface, embedded iron drift-bolts were found free from rust.

Albert A. Trocon, M. Am. Soc. C. E., speaks of a bridge over the Osage River, Missouri, built on iron cylinder piers filled with Louisville cement limestone concrete, which was wrecked by high water after seven years' service. The center pier was overturned, leaving the bottoms of the cylinders, after the water subsided, in plain view. The concrete was removed from these cylinders for a depth of 8 or 10 ft., and the iron was found absolutely free from rust.

Professor Charles L. Norton made a large number of experiments with concrete bricks, 3 by 3 by 8 in., in which steel rods, sheet steel and expanded metal were embedded. The specimens were enclosed in tin boxes with unprotected steel, and exposed for three weeks. One portion was exposed to steam, air and carbon dioxide, another to air and steam, another to air and carbon dioxide, and another was left on the table in the testing-room. His conclusions were as follows:

First.—Neat cement is a perfect protection.

Second.—Concrete should be dense without voids or cracks, and be mixed wet.

Third.—The corrosion found in cinder concrete is mainly due to iron oxide in the cinders and not to the sulphur.

Fourth.—Cinder concrete, if free from voids and well rammed, is about as effective as stone concrete.

Fifth.—It is important that the steel be clear when embedded in concrete.

Sixth.—It is essential that the steel be coated with cement before embedding in concrete, the unprotected pieces of steel being found to consist of more rust than steel.

M. Breuillié, a French engineer, made some interesting and valuable experiments on concrete-steel slabs subjected to high-water pressure. The slabs were 36 by 39 by 11.8 in., with steel rods and wires embedded at different depths in the slabs. The slabs were subjected for six days to intermittent water pressure of from 39.4 to 50.0 ft. The water penetrated every part of the slabs. The slabs were then left in the open air, and the condition of the metal tested from time to time and always found in perfect condition. He observed that the metal was dull after contact with the concrete; that adhesion was destroyed where the water had penetrated; that bars, having a slight layer of rust when embedded, were free from rust in 15 or 20 days; that water after passing through the slabs contained less mortar salts than before; that under pressure of 50 ft., adhesion was destroyed but bars did not rust. He concludes that a salt is formed by the action of the cement on iron, which is dissolved by water.

Professor Norton gives the result of further tests on the protection of steel embedded in concrete. Specimens of steel, clean and in all stages of corrosion, were embedded in stone and cinder concrete, wet and dry mixtures, and exposed to moisture, carbon dioxide and sulphurous gases. Some were treated in tanks supplied intermittently with steam, hot water, moist air, dry air, and continuously with carbon dioxide for from one to three months. Under the conditions followed, unprotected steel vanished into streaks of rust, but protected by an inch or more of sound concrete, the steel was absolutely unchanged, and he concludes that steel embedded in concrete, mixed wet and well, whether stone or cinder concrete, will be perfectly protected for all time.

Mr. Ransome mentions that in tearing up some sidewalk in Bowling Green Park, New York city, which had been in use 20 years, some embedded steel rods were found to be in perfect condition. Other examples could be given, but the writer considers the above sufficient to clearly establish that concrete is a perfect protection for embedded steel.

Cement Paint.—Cement paint is said to be largely used by the railroad companies of France, to protect the metal work of bridges from rust and locomotive gases. The metal is brushed and dampened and given two coats of liquid cement and sand. It was used for protecting the steel beams of the Boston Subway, and is used largely in European distilleries for painting iron spirit tanks, the adhesion being increased by allowing the metal to rust somewhat before applying the paint. The writer knows of some cases in the United States where cement paint was used without success, as it failed to adhere to the entire surface, and if there is any sure way of making it do so the writer hopes the discussion will bring it out, for if satisfactory adhesion of cement can be secured, either with or without sand, it will undoubtedly prove to be the best paint and the most perfect protection for exposed steelwork known. For protecting steel bars buried in earth, the writer has wrapped them with canvas soaked in thick Portland cement grout with a heavy coating of grout over the canvas, and believes it will be permanently effective.

Finish.—The greatest objection to the use of concrete for the exposed surfaces of structures in which beauty is an important consideration is the difficulty of producing a satisfactory finish. Concrete, as it usually comes from the moulds showing the joints, knots and grain in the casing, has more the appearance of a piece of rough carpenter work than of finished masonry, and some special treatment is necessary. Concrete is faced frequently with masonry, brick or tile, but this dodges the case without meeting it. Plastering is resorted to frequently, but not always with success. E. Duryea, Jr., M. Am. Soc. C. E., mentions some examples which gave good results. The portals of two tunnels in Los Angeles, Cal., were plastered with two coats of 1 cement, 4 sand and 1 lime paste; where finished rough it did not show hair-cracks, but when finished smooth it did show them. The concrete pedestals of Kaskaskie Viaduct, Chicago & Eastern Illinois Railway, are plastered with 1 cement, 1 sand, and are in first class condition. The piers of the Arkansas River Bridge, Kansas City Southern Railroad, were plastered with three coats, the first two, 1 cement, 3 sand, and the third, 1 cement, 1 sand, and are in good condition. Mr. Duryea considers a mixture of 1 cement, 3 sand, 1 lime paste the safest and best, and that excessive troweling should be avoided, and the plastering kept damp for two weeks. A concrete bridge at Oconomowoc, Wis., built by Stamsen and Blome, of Chicago, Ill., had a mortar face composed of 1 part cement, 1 part granite screenings and 1 part torpedo sand. On the second day after completion the moulds were removed and the surface rubbed with a soft stone and water. The Inman arch Hohenzollern had a facing of 1 part cement and 5 parts broken limestone. After setting 12 hours the loose cement was removed by water and brushes.

Impermeable Concrete.—Impermeable concrete, or concrete made impermeable by some kind of waterproofing coating, is frequently required, either for inclosing a space which must be kept dry, or for storing water or other liquids, and quite a number of valuable experiments have been made for the purpose of discovering the most effective way to accomplish this result.

In 1902, Mr. J. B. McIntyre and A. L. True, Jun. Am. Soc. C. E., of the Thayer School of Civil Engineering, made 97 experiments to determine if possible a concrete which would be impermeable to water under high pressures. The specimens were 10 in. in diameter and 9 in. high, with ¾-in. pipe inserted to a depth of 4 in. The specimens were subjected to a pressure of 20, 40 and 80 lbs. per sq. in. for two hours. All specimens containing from 30 to 45 per cent. of 1:1 mortar were impermeable, some of the specimens containing from 40 to 45 per cent. of 1:2 mortar, and some specimens of 1:2:4 and 1:2½:4 were also impermeable under a pressure of 80 lbs. per sq. in., equivalent to a head of 184 ft. They recommend 1:2:4 or 1:2½:4 concrete for moderate pressures.

Various coatings have been used to render concrete water-tight. For cistern work two coats of Portland cement grout has been found sufficient. About 1 in. of rich Portland cement mortar has usually been found effective under high pressure. A coating of asphalt alone, or asphalt with tarred or asbestos felt laid in alternate layers between layers of concrete, has often been used with success. Coal-tar pitch and tarred felt in alternate layers has been used extensively and successfully in New York City for waterproofing. Captain William C. Langfitt, Corps

of Engineers, U. S. A., has used successfully a waterproofing wash composed of one pint of an alum and lye solution mixed with 10 lbs. of cement, thinning with water until the mixture spreads easily with a brush. It should be applied while the concrete is green and until it lathers freely. The solution consists of 1 lb. of concentrated lye, 5 lbs. of alum, and 2 gal. of water. Eugene W. Van C. Lucas, M. Am. Soc. C. E., Captain, Corps of Engineers, U. S. A., used boiled linseed oil with success, coating the surface until the oil ceased to be absorbed.

Stone Dust vs. Sand.—A large number of tests have been made on mortars and concretes in which stone dust and sand have been used in direct comparison, and there can be no doubt that stone dust is much superior to any sand. Harry Taylor, M. Am. Soc. C. E., Captain, Corps of Engineers, U. S. A., tested 1,650 briquettes of 1:3, 1:4 and 1:5 mortars, at 1, 3, 6 and 12 months, using standard crushed quartz, Plum Island sand and crusher dust. The briquettes with crusher dust had a mean strength 72 per cent. greater than with crushed quartz, and 2.3 times greater than with Plum Island sand. A 1:5 mixture with stone dust was stronger than a 1:3 mixture with crushed quartz.

Wet or Dry Mixtures.—Until within the past few years the majority of engineers in the United States preferred and used a dry mixture of concrete, but now this has been superseded almost completely by a medium, or very wet mixture, often so wet as to require no ramming whatever. Mr. A. S. Cooper, Government Engineer, as long ago as 1895, called attention to the advantages of a wet mixture. He found by experiment that dry mortars give the best results in short-time tests, and wet mortars in long-time tests. Alfred Noble, Past President, Am. Soc. C. E., and George W. Rafter, M. Am. Soc. C. E., have also made a large number of tests of briquettes with dry, medium and excess mortars, and, although the dry mortars gave slightly the best results for these small specimens, they prefer the wetter mixture for actual work. H. W. Parkhurst, M. Am. Soc. C. E., made some valuable experiments on medium, dry and wet mixtures, and found the medium mixture most dense, wet next and dry least, and concludes that the medium mixture is the most desirable, one that will not quake in handling, but will quake under heavy ramming. He found medium 1 per cent. denser than wet, and 9 per cent. denser that dry concrete; he considers thorough ramming important. The writer has seen concrete put in so wet that it would not only quake but flow freely, and after setting it appeared to be very dense and hard, still he thinks the present tendency is for too much, rather than for too little water, and that thorough ramming is desirable.

Impurities in Aggregates.—It has been known for some years that quite a large percentage of clay in sand or gravel had no bad effect on mortars and concrete, but loam was considered fatal, and the writer has had some experience which seemed to justify such a conclusion; but quite recently some tests have been made by J. C. Hain, Assoc. M. Am. Soc. C. E., Chicago, Milwaukee & St. Paul Railroad, which seem to show that sand containing loam is equal to or superior to clean sand. Tests were made on 1:2 and 1:3 mortar, comparing clean sand with sand containing 2, 5, 10 and 20 per cent. of loam (rich surface soil). For the 1:2 mortar, clean sand gave slightly better and more uniform results, but for the 1:3 mortar, sand containing up to 20 per cent. of loam by weight gave as high average results as clean sand, though the latter gave much more uniform results. Tests were also made with sand from different pits and containing from 2.5 to 7.7 per cent. of loam and clay, and those containing the highest percentage of impurities give the best results. Tests made by the Board of Public Works of Porto Rico on briquettes of 1:2 mortar give 25 per cent. better results with washed than with unwashed sand. Before accepting sand containing a large percentage of foreign matter, the writer believes that thorough tests should be made of that particular sand, washed and unwashed.

Retempering.—Many engineers believe retempering to be injurious to Portland cement concrete, and forbid it in their specifications, but many tests have been made that show this to be a benefit rather than otherwise. Tests made by Thomas S. Clark, Resident Engineer, Manhattan Power Station, New York City, on 1:3 Rosendale and Portland mortars retempered after 1 hour, and tested at ages of 28, 56 and 112 days, show that the Rosendale mortars lost an average of 35 per cent. in strength by retempering, and that the Portland cement mortars gained an average of 8 per cent. in strength by retempering. Mr. G. T. Skeels, Assistant City Engineer, Sioux City, Iowa, made tests on 50 briquettes of 1:2 Portland cement mortar, which were continuously mixed for from 15 min. to 8 hr. 55 min., water being added from time to time, and tested after 15 days. The briquettes that gave the highest test were from mortar which had been continuously mixed for 4 hr. 55 min., and were 31 per cent. stronger than the specimens from mortar mixed for 15 min. Specimens from mortar mixed for 8 hr. 55 min. were 24 per cent. weaker than those from mortar mixed for 15 min.

Delay in Placing.—The Kinipple system of laying concrete under water consists in allowing concrete to partly set, so that when thrown into foundations the cement will not separate, but the concrete is soft enough to form a compact structure. He found it equal in every respect to concrete deposited in air, and found by experiment that 1:3½ concrete does not lose strength by delay of eight hours in placing, and if rammed into moulds will form a monolithic mass. A 1:3½ mixture was left three hours to set, and a 1:6 mixture, five hours before being deposited. The best results were obtained when the concrete was mixed with a minimum of water and rammed into boxes, and deposited when it had the solidity of stiff clay; he has deposited concrete in this manner through from 50 to 70 ft. of water with complete success.

Mr. Ransome says he has experimented with several brands of Portland cement, and found that they were invariably improved in tensile strength by a delay of from 1 to 4 hours between mixing and placing.

Freezing.—Walter A. Rogers, M. Am. Soc. C. E., of the Chicago, Milwaukee & St. Paul Railroad, made some interesting tests on 12-in. cubes of Portland cement concrete 1:3:4, exposed to freezing weather. The capacity of the testing machine was only 185,000 lbs., and it is unfortunate that the cubes were not of smaller size, or a more powerful machine used, but the results are of some value. Two cubes left in office, and tested after 28 days, stood over 185,000 lbs. Two cubes exposed to — 15 deg. Fahr., and tested after 28 days, crushed at 115,000 lbs. Two cubes exposed to — 15 deg. Fahr., for 28 days, and then kept in warm room for 28 days more and tested, stood over 185,000 lbs. Two cubes mixed with salt-water (1 pint of salt to 10 quarts of water) and exposed to — 15 deg. Fahr., and tested after 28 days, stood over 185,000 lbs. Mr. Rogers concludes that freezing before setting does not injure Portland cement concrete, even if, after having frozen hard, it is exposed to alternate freezing and thawing, and that the use of salt largely counteracts the effect of cold in causing slow hardening. Similar tests were made on cubes of Louisville cement concrete and with the same conclusions, except that salt was not beneficial. Mr. James S. Costigan read a paper before the Canadian Society of Civil Engineers, giving the result of 15 sets of tests on cement briquettes exposed to different conditions of freezing and thawing, and found but little, if any, loss of strength by freezing.

A large number of tests have been made which appear to show that freezing does injure Portland, or Natural cement concrete. Percy L. Barker and Henry A. Simonds, as a result of 7,150 tests, conclude that Portland cement mortar suffers no surface disintegration, but that strength is sometimes injured as much as 40 per cent. by freezing. Specimens mixed with water containing 1 part salt to 15 parts water by weight gave best results and suffered but little loss of strength by freezing. Experiments made by E. H. Conner at Cairo, Ill., found that the addition of salt increased the strength of Portland cement concrete. Mr. A. G. Fogg, who experimented on Portland cement mortar exposed to alternate freezing and thawing, concluded that a quick-setting mortar may freeze in 12 hours without injury, but that it is not safe to allow a slow-setting mortar to freeze in less than four days. None of these tests are conclusive, and none of them, as far as the writer has been able to discover, prove that Portland cement mortar or concrete is permanently injured by freezing or alternate freezing and thawing. It is well known that freezing greatly delays setting, and it is manifestly unfair to compare a test-piece which has been frozen for 27 days and thawed out on the 28th day, with one which has remained in the testing room 28 days, and to conclude that freezing has injured the concrete to the extent of the difference shown. It would be much nearer the truth to assume that setting was suspended for the length of time that the specimen was frozen, and to allow the frozen specimen the same length of time in the testing room as the unfrozen specimen before testing and comparing results. Very few engineers place much reliance on the tensile strength of concrete, and compression tests on cubes would have much greater value than tension or transverse tests. The tests made by Mr. Rogers, of the Chicago, Milwaukee & St. Paul Railroad, previously referred to, are in the right direction, and if his machine had been able to crush the specimens in all cases, it would have nearly settled the question of the advisability of laying concrete in freezing weather, and the Committee on Uniform Tests of Cement of the American Society of Civil Engineers cannot do a better service than to continue experiments on that line.

It is quite customary in laying concrete in freezing weather to either heat the materials before mixing, or to let steam and hot water into the mixing box, the concrete being deposited quite frequently when very hot. W. W. Maclay, M. Am. Soc. C. E., made many experiments, from which he concluded that this is not good practice. Two sets of briquettes of 1:2 mortar were made, one at 40 deg. and the other at 100 deg., exposed to freezing weather, and tested in 28 days. The 100 deg. specimens gave a strength of only 30 per cent. of the 40 deg. specimens. Experiments on 1:2:5 concrete gave similar results, and experiments on neat cement worse results. He considers that materials should not be heated except to thaw the frost out of the stone and sand. All specimens mixed

cold seemed to set and not to freeze in temperature of 13 deg., but hot concrete, on the contrary, invariably froze, and specimens placed in water always dissolved. He considers that no good work can be done under water in winter when the materials are heated. Those tests were made 27 years ago with Burham cement, and mostly with neat cement at age of seven days, and are not conclusive. Further tests in this direction are much needed, using modern concrete tested in compression, and subjected, as nearly as possible, to the same conditions met with in ordinary winter practice. Heated concrete laid in freezing weather is usually deposited in wooden moulds, which protect it to a great extent against frost. It is also covered at night, and, as far as practicable, as the work progresses during the day, and there is considerable evidence which appears to show that such work is good. The Melan Bridge, at Mishawaka, Ind., previously referred to (three spans of 110 ft. each,) Alonzo J. Hammond, Engineer in Charge, was built between Oct. 26, 1903, and Feb. 25, 1904, in temperature ranging from 0 to 55 deg. above. The concrete was heated by admitting hot water to the mixer, and was deposited at about blood heat, and retained sufficient heat after 48 hours to melt snow. The center arch was completed on Feb. 13, 1904, temperature about 25 deg. Fahr.; on February 14, the temperature dropped to 0 deg., and on March 1, or 15 days after completion, an ice jam took out the centering and left the arch unsupported. No bad effects could be observed, and the settlement of the arch was but little more than for the other spans when the centerings were removed later in the regular way. If the concrete had not been heated, it would be interesting to know whether the result, under such trying conditions, would not have been much worse.

Theories for Reinforced Concrete Beams.—Quite a number of theories or formulas have been advanced for the calculation of concrete-steel beams, most of them based on the common theory of flexure, with no allowance made for tension in the concrete, and the belief is quite general among the highest authorities on reinforced concrete in all parts of the world, that such theories are the safest and best. The writer has compiled the results of quite a large number of experiments on beams, in which the ratio of length to effective depth ranged from 6.0 to 22.2, the ultimate strength of metal, from 50,000 to 100,000 lbs. per sq. in., the area of metal, from 0.31 to 3.9 per cent., and the age of concrete, from 23 to 90 days, and in each set of tests compared the results agreed with theory as closely as would have been the case with steel beams; but such results cannot always be expected, as the modulus of elasticity of concrete, which enters into the calculation, is rather an uncertain quantity, depending on the quality of ingredient, mixture, mixing and placing, age and stress. Professor Brik makes a distinction between the modulus of elasticity and modulus of deformation, and considers that the latter, which is less than the modulus of elasticity by the amount corresponding to permanent set, should be used. Permanent set also causes internal stresses in beams after the load has been removed, so that any theory may be regarded only as an approximation.

The French Government appointed a commission of experts to establish a building code for concrete-steel structures. The steel reinforcement is considered as taking the whole tensile stress. The Prussian regulations for reinforced concrete buildings, issued by the Minister of Public Works of Prussia, provide that the steel shall be considered as taking the entire tensile stress in beams. The regulations of the Bureau of Buildings of the Borough of Manhattan require the same thing, and, as far as the writer knows, this is true of all other cities which have formulated rules on the subject.

The opinion that the tensile strength of concrete should not be considered, is much strengthened by the result of experiments on concrete-steel beams, made by F. E. Turneaure, Assoc. M. Am. Soc. C. E., and given at the annual meeting of the American Society for Testing Materials, July, 1904. The beams were tested with the tension side up, and cracks first appeared at a certain amount of deflection, whether steel was present or not. With 1:2:4 concrete minute cracks were first observed at an elongation of 0.0001 to 0.00015; they were visible to the naked eye (if the beam was dry) at an elongation of 0.0004 to 0.0005 (12,000 to 15,000 lbs. per sq. in. in the steel), and then generally extended across the tension surface and some distance along the sides of the beam. These results show clearly that the steel loses its tensile resistance at an early stage of the loading.

The Railroad Cross-Tie Problem.

BY S. WHINERY, CIVIL ENGINEER.

The Cross-tie problem is always one of interest to railroad men. Assuming that on the 200,000 miles of steam railroad in the United States an average of 2,750 ties are used per mile, that the average life of these ties is eight years, and their average cost, in the track, 45 cents, the cost of cross-ties amounts to the enormous sum annually of over 30 millions of dollars. The question of the substitution for wooden cross-ties, of those made of some other material, particularly of metal or concrete, is being largely and increasingly discussed.

Having recently given some attention to the subject of cross-ties and other forms of track support, and the comparative merit of different kinds of ties, perhaps a summary of the conclusions reached and some of the reasons leading to them may be of interest to the readers of the *Railroad Gazette;* at least it may help to clear conceptions of the problems involved. It is not possible in an article of reasonable length to discuss the subject in much detail, nor in a strictly scientific manner.

The merits and the defects of the wooden cross-tie are well known. Its practically exclusive use in the United States ever since our railroad system began, furnishes us with very satisfactory data as to its efficiency, cost and economy. In any discussion of other kinds of ties we may therefore use it as a standard for comparison. Until some other kind of cross-tie shall be found to be, upon the whole, better and cheaper, there will be no advantage in adopting a substitute. The object of this article is mainly to inquire into the relative efficiency and economy of substitutes proposed for the wooden tie. Under the head of efficiency, is, of course, included the element of safety.

Disregarding for the present the question of cost and economy we may first summarize the qualities requisite in a cross-tie, as follows:

1. Sufficient area of bearing surface upon the ballast to safely transmit to the roadbed the weight and impact of the rolling stock.
2. Sufficient strength, resilience and endurance to give satisfactory service under the conditions to which it is exposed.
3. Capacity to hold the rails to "gage" and in a position perpendicular to the plane of the track.
4. Sufficient frictional resistance or "grip" in the ballast to prevent lateral movement of the track.
5. The interval between supports to the rail must be so short that deflection of the rail under its loads will be practically nil.
6. The attachment between rail and tie must be secure and efficient, and should be as simple and as accessible for adjustments and repairs as possible.
7. Facility of Maintenance: The tie should be of such form and section as will permit the ballast to be properly and securely tamped under it, and the track kept in line and surface.

The standard wooden tie meets these requirements fairly well. We may call its dimensions 8 ft. long, 8 in. wide and 6 in. thick. Its average effective width, owing to the large number of "pole" ties used, may be safely placed at 8½ in. With 16 such ties used to each rail-length of 30 ft., the bearing surface on the ballast is equivalent to 2.93 sq. ft. per linear foot of single track, or 1.46 sq. ft. per linear foot of rail. Under our modern locomotives such a tie may easily have to transmit to the ballast a weight of at least two tons per sq. ft. of this bearing surface. Considering the impact character of this load, it is as great as should be permissible, and any substitute for the present cross-tie should afford equal bearing surface per linear foot of track.

Wood, particularly white oak and long-leaf yellow pine, possesses in a high degree the qualities of strength, elasticity and toughness necessary to stand the severe conditions to which a railroad tie is subjected.

The wooden tie has sufficient rigidity to hold the rails perpendicular to the plane of the track, and, barring the yielding of the spikes, has a surplus of strength to hold the rails to gage. With good metal tie plates the defect in the lateral holding power of the spikes is largely overcome, and by the use also of screw spikes this defect would probably disappear except where soft wood ties are used. In frictional resistance to lateral track movement the wooden tie is not always satisfactory, particularly on curves, where the tendency to lateral deformation of track is greatest. Certainly no substitute possessing this quality in a lesser degree should be considered acceptable.

With 16 ties used per rail-length the rail is supported at intervals of less than two feet. Even with our heaviest rail-sections the rail supports should not be more than two feet apart. The weight of rolling stock is rather more than keeping pace with the increased resistance of heavy rail-sections, and we cannot, therefore, safely increase the distance between supports.

With the ordinary driven spike the attachment of rail to wooden ties is not very satisfactory. Besides the liability of the spikes to be withdrawn, the frequent driving of them into the wood destroys the fiber, impairs its holding power, and promotes the decay of the wood. Without the use of tie plates the cutting of the rail into the wood is a serious defect. These weaknesses become more serious as the life of the tie is prolonged by preservative treatment. But with good tie plates and screw spikes these defects may be largely mitigated. The width and spacing of the wooden tie affords ample facility for manipulating and tamping the ballast under it and for keeping the track in line and surface.

It will not be claimed, however, by any one, that the wooden tie is, in any of the requirements enumerated, better than it should be, and if we are looking for a substitute it must be equal to, or at least must compare favorably with the wooden tie in all these particulars. Any fair comparison between them (omitting still the question of cost and economy), must be upon the basis of equal capacity to meet the same essential requirements.

In figuring the strength of a tie we must consider the nature of the stresses to which it is exposed. In use the ordinary cross-tie

acts as a continuous beam. We may reverse the ordinary conception and consider it as a beam supported at two points (the rails), and uniformly loaded with the pressure of the ballast due to the weight of the wheels of the rolling stock upon the rail. The ends of the beam overhang the supports at each end, forming cantilevers. Under the action of the uniform load (i.e., the pressure of the ballast) the beam tends to take the form shown in Fig. 1. It is subjected to strains acting in opposite directions. At the center of the track the strain tends to break the tie by tension on its upper fibers, while directly under the rails, the strain in the opposite direction tends to break it by tension on its lower fibers. Where the tie is 8 ft. long and the gage of the track is 4 ft. 8½ in., the strain at the middle of the tie is about one and one-half times that under the rail.

But while thoretically correct, too much importance must not in practice be attached to this conception of the strains to which a tie is subjected for the reasons—first, that unless the distribution and tamping of the ballast under the tie is uniform the load will not be uniform, and, secondly, the frictional resistance among the fragments of the ballast may be such that under any deformation of the tie, the loading would not be uniform. The principle involved has, however, an application to concrete ties that cannot be neglected, which will be considered later. It has also an interesting application, worth noting, in the case of all ties. The ordinary cross-tie being of the same size and strength from end to end, it is obviously desirable to reduce as much as possible, and to equalize the maximum strains to which it is subjected. In other words, the total strain should be divided as equally as practicable between that at the center and that under the rail. Now if the tie be made 8.4 ft. long this will be theoretically accomplished, and the strain on the middle of the tie will be reduced about one-sixth. This seems to be a matter of sufficient importance to deserve more attention than it has received, particularly since increasing the standard length of ties from 8 ft. to 8 ft. 5 in. would usually not increase their market price.

In practice, however, in comparing the strength of various kinds of ties, we may safely consider them as simple beams placed upon supports, an equal distance apart and uniformly loaded throughout their length; or what is still simpler, and more scientific, we may say that the strength of two ties is in direct ratio to the moment of resistance of their sections. Now the moment of resistance of a wooden tie 8 in. wide and 6 in. deep, allowing an extreme fiber strain of 1,000 pounds per sq. in., is about 48,000 inch-pounds, and we may adopt this as a standard in comparing the strength of other ties proposed as substitutes for the wooden tie.

The substitutes for the wooden tie that have been seriously considered fall into four general classes:

1. The steel or iron beam tie.
2. The cast-iron tie or track support.
3. The concrete tie reinforced with steel.
4. The combined concrete and steel beam tie.

1. Many experiments have been made abroad and not a few in this country with cross-ties taking the general form of steel or iron beams. But the section adopted has not been, as a rule, one to develop the greatest strength per unit of area of metal used. An inverted trough or channel has been most frequently chosen. It may be readily shown that this section does not afford an economical disposition of the material used. This will be referred to later. Everything considered, the common "I" beam may be taken

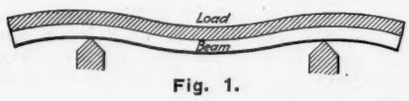


Fig. 1.

as the general form which, with the load acting through and parallel to its web, develops the greatest strength per unit area of metal used. We may, therefore, reasonably assume that if it lends itself to the purpose equally well in other respects than strength, it is the most promising section to use in designing a metal cross-tie. Fig. 2 shows an attempt at such a design. This tie has the same length as the standard wooden tie—8 ft.—and if placed in the track 2 ft. from center to center of ties, it gives the same bearing surface on the ballast as the wooden tie—2.93 sq. ft. per linear foot of track. Allowing an extreme fiber strain of 10,000 lbs. per sq. in. the section has a moment of resistance of about 47,000 inch-pounds, being practically equal therefore in bearing surface and strength to the standard wooden tie. It has a tie-plate riveted to the upper flange, of such form and dimensions that the rail may be secured to it by bolts which may be inserted, removed or adjusted without disturbing the tie. The frictional resistance to lateral displacement of track would not be equal to that of the wooden tie. The rivet heads below the base plate would have some value in this respect, and if found necessary anchor lugs could be riveted to the bottom plate without materially increasing its cost. The tie complete would weigh about 171 pounds. Its cost delivered on the road where it is to be used would vary with the prices of material, labor and transportation. At the present time that cost, including a reasonable profit to the manufacturer, would probably not be below $4.25. Such a tie ought to prove as efficient and satisfactory in service as the standard wooden tie. What its useful life would be is a question which we have not sufficient data from experience to answer satisfactorily. Judging from such data as we have, it would probably be safe to predict a life of 25 years, if properly painted and cared for.

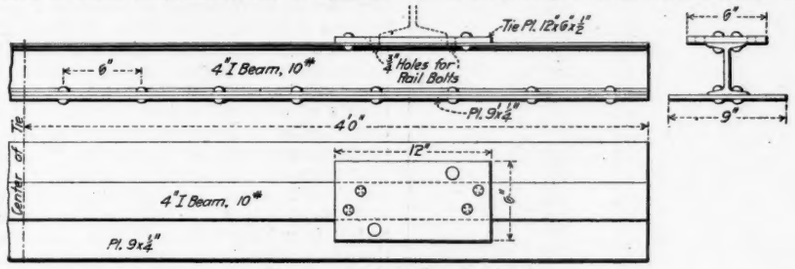


Fig. 2—Design for Steel Tie.

Quantities and weights:	
1 I-beam 8 ft. long at 10 lbs.	80 lbs.
1 bottom plate 8 ft. x 9 in. x ¼ in.	61 "
2 tie plates, 12 in. x 6 in. x ½ in.	20 "
40 rivets at ¼ lb.	10 "
Total	171 lbs.
Moment of resistance fiber stress 10,000 =	46,506.
Cost: 171 lbs. at 2½ cts.	$4.27

Comparing this tie with the steel or iron ties that have been most used experimentally, its greater weight will be at once observed. But the material used is well disposed to develop its greatest strength, and this strength is certainly not greater than that of the wooden tie with which it is to be compared. The steel and iron ties that have been mostly tried have been so deficient in strength and rigidity that their failure under heavy rolling stock was to be expected, and such failure cannot be considered as a valid argument against the tie here proposed. The superiority of the section over the common inverted trough form is very notable. Thus a tie of the latter form having a top plate 9 in. x $^{5}/_{16}$ in., with vertical sides ½ in. thick and $4^{11}/_{16}$ in. deep, has a sectional area over 40 per cent. greater and a moment of resistance nearly 40 per cent. less than our I-beam tie. Its form is, besides, very objectionable from the point of view of tamping the ballast under it.

2. Cast-iron is obviously unsuitable for cross ties, but cast-iron supports for the rail, usually in the form of inverted "pots" have been quite extensively used abroad, and apparently with good success where the service is comparatively light. They have been, however, deficient in bearing area on the ballast, measured by the standard we have set up, and probably also deficient in strength to carry the heavy rolling stock of American trunk lines. Their form is an objectionable one for tamping ballast under them, and the rail fastenings are not satisfactory. An attempt by the writer to design a promising cast-iron track support for comparison with the wooden tie has resulted in the form shown in Fig. 3. It gives the same bearing surface as the wooden tie. The opposite supports are tied together so as to preserve the gage and to give some rigidity to the structure, and the castings are made strong enough to probably bear the stress upon them. The rail fastening bolts can be removed and replaced without disturbing the casting in the ballast. The width of the casting, 14 in., is as great as allowable (where the supports are but 24 in. apart) to permit of proper tamping. This consideration excludes the wider spaced circular form of "pot," used abroad, which would be otherwise desirable. To facilitate tamping under so wide a surface the edges are slightly curved upward. The transverse ribs cast on the bottom not only increase the strength, but serve as anchors in the ballast to prevent shifting of the track laterally.

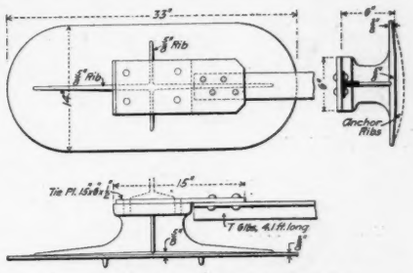


Fig. 3—Cast-Iron Track Support.

Weights:	
2 castings at 90 lbs.	180 lbs.
1 steel tie and plate	52 "
Total	232 lbs.
Cost:	
180 lbs. c.-i. at 2¼ cts.	$4.05
52 " steel at 2½ cts.	1.30
Total	$5.35

The weight of one pair of these supports, and the connecting tie rod taking the place of one cross-tie, would be about 232 pounds, of which 52 pounds would be steel. A fair

estimate of the cost of the pair would be about $5.25, delivered.

No reason is apparent why this design should not give fairly satisfactory results in practice, though the wisdom of using cast-iron where it is constantly subjected to such shocks as result from the passage of our modern rolling stock may well be questioned. The cast-iron would be less liable to rust than steel, and, possible breakage excluded, such a support should last a long time. Even allowing for their liability to break, 30 years effective service might be reasonably expected.

(To be continued.)

Poor's Statistics for 1903.

The advance sheets of Poor's Manual for 1904 contain the usual statistics of the railroads in the United States for the fiscal year ending in 1903. A summary of some of these figures is given below. The total length of railroads completed on Dec. 31, 1903, is given at 207,604 miles, an increase for the year of 4,595 miles.

	1903.	1902.
	Miles.	Miles.
Mileage of railr'ds.	206,885.99	199,684.64
2d track, sid'gs, &c	79,376.03	75,150.75
Total Track	286,262.02	274,835.39
Steel rails in track	271,012.70	257,437.11
Iron rails in track.	15,249.32	17,398.28
	No.	No.
Locomotives	44,529	41,626
Cars—Passenger ..	28,648	27,364
Bag., mail, etc...	10,182	9,726
Freight	1,524,150	1,503,949
T'l revenue cars.	1,562,980	1,541,039
Liabilities:		
Capital stock	$6,355,207,335	$6,078,290,596
Bonded debt	6,722,216,517	6,465,290,839
Unfunded debt	448,199,448	310,345,867
Current accounts..	648,434,976	479,957,935
Sink'g & other f'ds.	115,201,683	140,679,814
Total liabilities..	$14,289,259,959	$13,474,565,051
Excess of assets...	572,851,585	479,542,767
Total	$14,862,111,544	$13,954,107,818
Assets:		
Cost, R.R. & equip.	$11,233,311,285	$10,865,683,376
Other investments.	2,653,851,625	2,345,515,940
Sundry assets	552,036,399	455,053,773
Current accounts .	422,912,235	287,854,729
Total assets	$14,862,111,544	$13,954,107,818
	Miles.	Miles.
Miles.R.R. operated	205,237.12	197,887.36
Rev. train-mileage:		
Passenger	429,014,116	403,213,178
Freight	548,680,595	508,210,140
Mixed	22,288,855	22,990,130
Total	999,983,566	934,413,448
Passengers carried.	696,949,925	655,130,236
Passenger mileage..	20,895,606,421	19,706,908,785
Tons freight moved.	1,306,628,858	1,192,136,510
Freight mileage ..	171,292,198,079	156,624,166,024
Earnings: Pass'g'r.	$429,705,287	$396,513,412
Freight	1,344,150,719	1,197,212,452
Miscellaneous ...	135,001,820	127,089,036
Total	$1,908,857,826	$1,720,814,900
Net earnings.....	592,508,512	560,026,277
Other receipts	89,485,484	77,663,483
Total avail. rev.	$681,993,996	$637,689,760
Payments:		
Interest on bonds..	$239,426,707	$222,614,909
Other interest	8,680,451	9,733,560
Dividends on stock.	164,549,147	151,019,537
Miscellaneous	61,336,614	57,408,351
Rentals: Interest.	38,675,121	40,622,542
Dividends	26,125,268	27,154,215
Miscellaneous ..	21,320,600	19,970,212
Total payments	$560,113,908	$528,523,326
Surplus	$121,880,088	$109,166,434

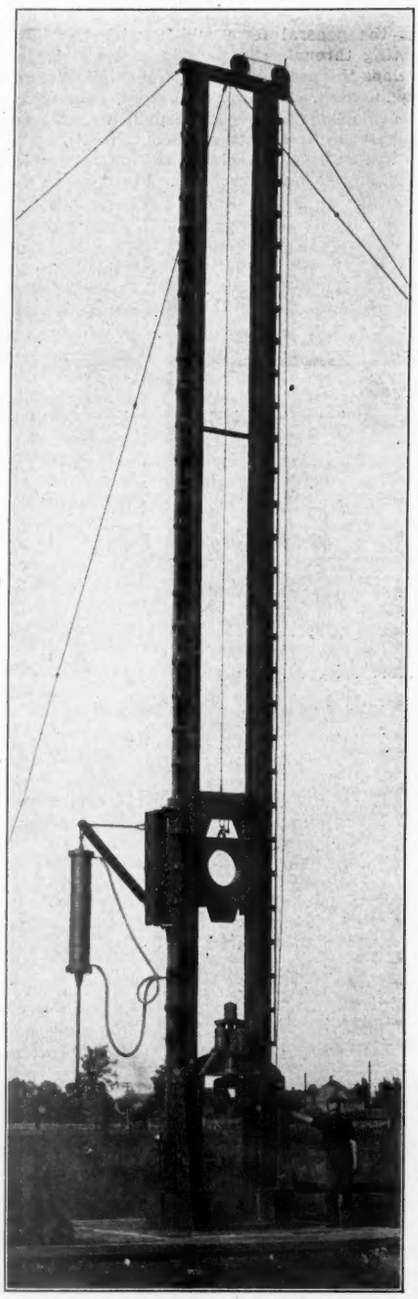
Total receipts increased 188 millions, or about 10 per cent.; freight earnings 147 millions and passenger 33 millions. The following table shows the average mileage operated, capital per mile, and bonded debt per mile of all steam railroads in the United States for the past five years.

	Mileage worked.	Capital stock per mile.	Bonded debt per mile.
1899.....	187,781	$30,579	$30,061
1900	192,162	30,205	29,967
1901.....	195,887	30,521	30,811
1902.....	199,685	30,439	32,377
1903.....	206,876	30,719	32,494

Gross earnings per mile of road in 1903 amounted to $9,301, and net earnings to $2,887, as compared with $8,696 and $2,830 respectively in 1902. The average ton-mile rate was 7.85 mills, as against 7.64 mills in 1902, and 7.56 mills in 1901. This average shows a steady increase since 1899. The average revenue per freight train mile was $2.444 against $2.356 in 1902, and $2.228 in 1901. The average receipts per passenger per mile in 1903, 1902, and 1901, were respectively, 2.05 cents, 2.01 cents, and 2.03 cents. The average interest rate on bonds was 4.13 per cent. in 1903, 4.07 in 1902, and 4.21 in 1901, while the average dividend on stock was 2.83 per cent. in 1903 as compared with 2.93 per cent. in 1902 and 2.62 per cent. in 1901. The ratio of operating expenses to earnings, 68.96 per cent., is the highest since 1897, when it was 69.74.

Master Car Builders' Drop-Testing Machine.

The accompanying illustration represents the Master Car Builders' drop-testing machine as it is now installed at the laboratory of Purdue University, Lafayette, Indiana.



M. C. B. Drop-Testing Machine at Purdue University.

Its drop weighs 1,640 lbs., and is of forged steel. Its weight meets the requirements of the Master Car Builders' specifications for coupler testing as well as those of the International Association for Testing Materials, with reference to axle testing. It can be made to meet the requirements of the last named association for rails by applying discs to the cylindrical opening which serve to increase the weight of the drop to 2,000 lbs. The drop is handled by a wire cable served by a reversible hoisting engine within the locomotive laboratory, at the right of the machine as it appears in the illustration. The anvil or base of the machine weighing 17,000 lbs. is carried by a nest of coiled springs which in turn are mounted upon a suitable foundation plate. It is assumed that the spring support of the anvil makes it possible to easily reproduce the machine; that is, that the resisting qualities of a similar anvil, similarly supported, will be the same whether the machine rests upon a rock foundation or upon soft soil. The machine rises to a total height of 55 ft.

The machine was developed by the Master Car Builders' Association. At its annual meeting in 1898, this association appointed a committee to define fully the contour lines of M. C. B. couplers, and to propose specifications which might guide railroad companies in the purchase of new couplers. This committee consisted of Messrs. W. W. Atterbury,[1] W. P. Appleyard,[2] and W. S. Morris.[3] The report which it presented at the next meeting dealt with the coupler question in a very comprehensive manner, recommending among other things that couplers offered to railroads be subjected to a series of tests under a drop-testing machine. The committee not only defined the nature of these tests, but presented a design for a machine to be employed in carrying them out, and gave results of tests which had been secured by the aid of an improvised machine to demonstrate the reasonableness of the specifications they proposed. It was in the work of Mr. Atterbury's committee that the present M. C. B. drop-testing machine had its origin, and it is a high tribute to this body, that though the question of drop-testing has been extensively studied since the date of its first report, the conceptions underlying the design of the machine which was then defined have not since been changed. As time went on, the original drop-testing machine, which had been at Altoona, was improved in matters of detail, and became useful not only in testing of couplers, but in testing of draft gears as well. Meantime, the chairmanship of the coupler committee had been transferred to Mr. R. N. Durborow,[4] who in this manner became responsible for the later development of the machine.

Its installation at Purdue places it upon neutral ground and under the same auspices as the association's air-brake testing rack and the brake-shoe testing machine.

[1]Now General Manager, Pennsylvania Railroad.
[2]Now Superintendent of Equipment, Pullman Co.
[3]Late Superintendent of Motive Power, Erie Railroad.
[4]Superintendent Motive Power, Pennsylvania Railroad.

The Prussian State Railroads have let contracts for steel rails and ties to the combined Prussian steel works at $26.65 per ton of 2,204 lbs. for rails, and $25 for ties on cars at the rolling mills. As an experiment heavy rails for 31 miles of track are to be rolled 15 meters (49 ft. 3 in.) long. The standard length is 39 ft. 4 in. The Austrian Northwestern Railroad has contracted with the combined rail mills of the country for its rail supply for 1905 at a price $4 per ton higher than at the last letting, when the Austrian and Hungarian works bid against each other.

GENERAL NEWS SECTION

THE SCRAP HEAP.

Increases of from 1½ cents to 2½ cents per 100 lbs. have been announced at Chicago in the rates on grain and grain products to the Atlantic seaboard. Beginning December 5 the rate on domestic shipments of grain will be 20 cents (increased from 17½) and on export grain 15 cents, increased from 13½. The rate on export flour is increased from 15 cents to 16½ cents.

In connection with the hearing on the complaint of W. R. Hearst against the anthracite coal roads, alleging excessive and discriminating rates, the members of the Interstate Commerce Commission this week visited a number of points on the Philadelphia & Reading, and other railroads, in the coal regions, for the purpose of seeing on the ground some of the evidence bearing on the cost of carrying coal.

The Pennsylvania Railroad has announced that three suburban passenger stations east of Pittsburg will be abolished—Ben Venue. Fifth Avenue and Brushton. It appears that the only reason given for abolishing these stations is the expected increase of through traffic over the line when the Brilliant cutoff is opened, but the diversion of passenger traffic from the steam road to electric lines is no doubt one of the reasons.

The Railroad Commission of Texas has issued a tariff of rates to be charged by railroad companies for storage of goods in freight houses. After 72 hours from date of notice of arrival, the charge is to be, per 100 lbs., for ten days or less, 5 cents; for 20 days, 7.5 cents; for 30 days, 10 cents, and so on. On L. C. L. shipments consigned to persons who live at "distant interior points" 20 days' free time must be allowed; how far distant is not stated.

The Supreme Court of the United States has dismissed the cases of the Interstate Commerce Commission vs. the Nashville, Chattanooga & St. Louis and the Interstate Commerce Commission vs. the Southern Railway. The complaint in the first case was that merchants in Palatka, Fla., can receive goods from St. Louis and from Tennessee points and reship them to and sell them in Hampton, in the same State, as cheaply as the Hampton merchants themselves. The southern case involved a charge of disparity in freight rates at Danville and Lynchburg, Va. The dismissal in both cases was made upon stipulation of counsel.

Gold Medal for the Continuous Rail Joint.

The jury of awards of the Louisiana Purchase Exposition has awarded the gold medal for rail joint fastenings to the Continuous Rail Joint Company of America, Newark, N. J. The display of this company in the Transportation building shows various types of rail joints made by the patented machinery controlled by the company in this country. These joints, because of care in manufacture and the resulting perfect fit, have three points of contact in one piece of metal, thus forming a rail joint of two symmetrical pieces. Over 20,000 miles of railroad track have been equipped with these joints within the past ten years. The company owns and operates the Albany Iron & Steel Works at Troy, N. Y., where it makes rolled steel joints for tee and girder rails, and also step or compromise joints to connect rails of different sections. These latter are made of cast steel. The company is now bringing out a new type of insulated rail joint, and also an electric bonding joint. A company in Canada has been organized to make these joints, and another corporation has been formed in London, England. This appliance has already been introduced in many foreign countries.

Trial of the Colorado.

The new armored cruiser Colorado on her trial trip near Boston on Oct. 23 made an average speed of 22.26 knots an hour, making 88 knots in about three minutes less than four hours. The Colorado was built by Wm. Cramp & Sons, of Philadelphia, and is 502 ft. long, 69 ft. 6½ in. beam, with a trial displacement of 13,680 tons. Her engines are of the four-cylinder vertical inverted direct-acting type for twin screws, and have 23,000 i.h.p. There are 12 Niclausse boilers and four smoke stacks. The maximum speed developed was 23.33 knots, which was maintained for 6.6 knots.

Electrification of London Underground Railroads.

The power house for the operation of the Metropolitan District, the Great Northern, Piccadilly & Brompton, the Baker Street & Waterloo, and the Charing Cross, Houston & Hempstead railways is nearing completion. Three-quarters of the machinery has been built, including two of the turbo-generators. The ducts and cables to Earls Court have been laid and connected. There has also been satisfactory progress in the conversion of the Metropolitan District Railway from the use of steam to electricity. All the cable ducts have been laid, the brackets and troughs for the cables on the sides of the tunnel have been installed and a large portion of the cables drawn in and connected. The conductor rails have also been laid and the bonding completed. The wooden station platforms are being replaced by concrete. The new fireproof cars have been ordered and deliveries will begin in November and December. Electrical equipment for the cars is now being delivered. The tunnels between Baker street and Waterloo stations have been driven and contracts have been let for the extensions between Baker street and Edgeware and between Waterloo station and the Elephant and Castle. The extension from Hammersmith, Broadway, to Uxbridge road via Askew road and the extension from Southall to Uxbridge have been opened for traffic.

A Safe (?) Grade Crossing.

A press despatch from Danville, Pa., says that in the case of the Delaware, Lackawanna & Western against the Danville & Bloomsburg (electric) road the Court has dissolved the preliminary injunction granted to prevent the defendant crossing at grade the tracks of the plaintiff. The Court holds that an overhead crossing is not practicable because it would be more dangerous to the public than the crossing at grade. An appeal will be taken by the plaintiff.

It would be interesting to know the facts on which this judge based his opinion. One can imagine a trestle approach to an overhead bridge sufficiently crooked and steep and flimsy to make one particularly apprehensive of a runaway. In some cases where cars have run away on a steep grade and have been overturned down a high bank the consequences to the passengers have been disastrous, but it would seem to require remarkable insight to reach any preference as between being killed in a runaway or in a car which is struck by a locomotive on a crossing. The situation at Danville must be about as bad as that of the darky who one Sunday heard it thundered from the pulpit that of the two roads that are constantly open before the weary pilgrim on the journey of life, one leads to destruction and the other to damnation. "This nigger, then, will take to de woods," was the audible comment of the hearer.

American Frog and Switch Company's Exhibit at the World's Fair.

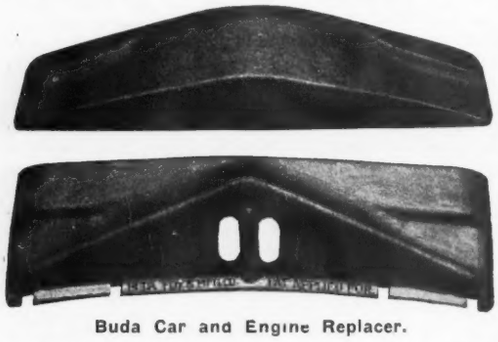
The exhibit of the American Frog & Switch Company, Hamilton, Ohio, at the World's Fair, St. Louis, is located in Aisle C of the Transportation Building and covers 1,000 sq. ft. of floor space. The full line of switches, frogs and switch stands made by the company is exhibited. It includes three different styles of split switches, one being a light-rail switch for industrial purposes; the company's standard split switch; and two designs of reinforced split switches with adjustable head rods. A design of riveted-plate light rail frog is also shown, and a standard bolted stiff frog. Spring frogs include the company's standard design and also a recently patented spring frog with hinged wing rail, reinforced by an outer, or easer, rail. This latter frog has received the favorable comment from those who have inspected it at the exhibit, and it is already in use on a number of railroads. Various types of switch-stands are shown, including a design for light rail work, a standard plain ground-throw switch, an automatic ground-throw switch, an intermediate design for plantation work, a standard high switch-stand and a high elevated target switch-stand. Frogs, switches and switch-stands for interurban and suburban railroads are also shown.

Dr. Black's Semaphore Charts.

F. A. Hardy & Company, Chicago, make a set of 17 cards, designed by Dr. N. M. Black, of Milwaukee, for testing the vision of railroad men. These cards are 8 in. wide and 4 in. high and have test letters and test illustrations of semaphores made of a suitable size to be hung 20 ft. from the observer. The letters are of the Snellen style and some of the cards have sizes suitable for a 15 ft., a 30 ft. and a 40 ft. test. The semaphores have arms about ⅜ in. long simulating a full sized semaphore seen at a distance of a half mile. The arms are colored (red, green or yellow) and the backgrounds are of a grayish neutral color, corresponding to the average tint of the sky. A set of these cards costs $1.

The Buda Car and Engine Replacer.

A new car and engine replacer is shown in the accompanying illustrations. The replacer is made of cast steel and is designed to support and guide the heaviest cars or engines without damage to the replacer or to the equipment. An important advantage claimed for this replacer is that it provides



Buda Car and Engine Replacer.

for carrying the wheel on the tread and guiding it by the flange at the critical time of starting a replacement. This avoids the danger of breaking flanges by allowing the weight to rest entirely on the point of the flange. The replacer is positive and gradual in its action and cars will not run over it but must travel to the track. A complete bulletin on the device is issued by the maker, the Buda Foundry & Manufacturing Co., Chicago.

The State of Washington.

The political fight in the State of Washington in the present campaign is centered almost entirely upon the question of the establishment of a railroad commission. For eight years a large number of the people of the State have demanded a commission, an elective one, but two Republican legislatures, although half pledged to take the matter up, have done nothing. Now an appointive body has been promised in the Democratic State platform, and the contest is being waged on this issue. There is little doubt that the majority of the people are in favor of a railroad commission of one kind or another. Washington is usually Republican by a majority of some 17,000. This year, however, political wiseacres believe there is a fair possibility of former United States Senator George Turner, of Spokane, Democratic gubernatorial nominee, being elected, simply because he is pledged to give the people the commission demanded, while A. H. Mead, the Republican nominee, is antagonistic to a commission at this time, particularly one to be appointed by the Governor. The Democrats propose a commission of three members, to be non-partisan. The business men and farmers of eastern Washington, the home of Senator Turner, are the most active, alleging that the railroads discriminate against Spokane and other eastern Washington points in favor of Seattle. Both the Northern Pacific and the Great Northern charge higher freight rates to Spokane on certain goods from the east than they do to Seattle, nearly 300 miles further west. The people of Washington, as a whole, however, have no particular complaint to make against the railroads of the State, and men not directly interested in business with the railroads desire a commission rather as a possible precautionary measure for the future.

Scherzer Rolling Lift Bridges.

Among the recent contracts of the Scherzer Rolling Lift Bridge Company, Chicago, Ill., are four-track bridges for the New York, New Haven & Hartford at Cos Cob and Westport, Conn., a second double-track bridge for the Jersey Central across Newark Bay and a double-track single-leaf bridge of 160 ft. span for the Newburg & South Shore across the Cuyahoga river at Cleveland, Ohio. The first Scherzer bridge built for the Metropolitan Elevated, Chicago, was completed in 1894. Since that time there have been built a six-track bridge for the New Haven at Boston, an eight-track bridge for the Pennsylvania, Chicago Terminal Transfer and Chicago Junction railroads in Chicago, a double-track two-leaf bridge of 275 ft. span for the Chicago Terminal Transfer at the entrance to the Grand Central Station, Chicago; one single and one double-track bridge for the Big Four at Cleveland, a double-track bridge across Newark Bay for the Jersey Central, and more than 50 other bridges in various parts of the world for railroad, street railroad and highway traffic ranging in span up to 216 ft. In Europe bridges of this type have been built or are building for the South Eastern & Chatham, for the Dutch State Railways and a highway bridge across the Ekaterinhofka river, St. Petersburg, Russia, besides a number of less important structures.

The Canada Car Company's New Plant.

The car manufacturing plant now being built by the Canada Car Company at St. Henri, near Montreal, is between the Grand Trunk Railway and the Lachine Canal, and is in close proximity to the Canadian Pacific Railway and the Intercolonial Railway. The site covers 50 acres of land, on which there will be about seven acres of buildings so grouped that extensions to each and every department may be economically made in the future. The buildings will be of steel construction with outside walls of concrete or brick, and will be covered with gravel roofs. The capacity of the shops at first will be about 10 passenger cars per month and 20 freight cars per day, with their corresponding trucks. Wooden cars will be the first product, but provision is being made by the company to make composite, wood and steel, and all-steel cars, pressed steel or structural shapes, and street cars and special types of trucks and bolsters, and other specialties used in car building. The methods of manufacture of the Pressed Steel Car Company will be closely followed and their patents will be used by the Canada Car Company. The buildings are arranged in two groups, and the power house, store house and office building will be separate from the main buildings. One group consists of the machine shop, brass foundry, forge and smith shop, gray iron foundry and wheel foundry. The second group consists of the planing mill, matching room, cabinet, pattern and carpenters' shops, trimmers and upholsterers, freight car erection, passenger car erection and wheel and axle and truck and bolster shops. Contiguous to this group will be the passenger and freight car paint shops. Most of these shops will be served by electric overhead cranes, and tracks will be laid throughout such shops as require them, and throughout the yard, so as to entail the minimum amount of movement. The floor area of the various shops is as follows:

Machine shop	129 ft. x 70 ft.
Brass foundry	86 ft. x 70 ft
Forge and smith shop	301 ft. x 70 ft.
Gray iron foundry	215 ft. x 70 ft.
Wheel foundry	215 ft. x 184 ft.
Planing mill	387 ft. x 70 ft.
Matching room	236 ft. 6 in. x 70 ft.
Cabinet, pattern shop and carpenters' department	236 ft. x 70 ft.
Trimmers' and upholsterers' shop	172 ft. x 70 ft.
Freight car erection shop	301 ft. x 70 ft.
Passenger car erection shop	301 ft. x 70 ft.
Wheel and axle and truck and bolster shops	301 ft. x 70 ft.
Passenger car paint shop	301 ft. x 70 ft.
Freight car paint shop	322 ft. 6 in. x 70 ft.
Store house	120 ft. x 80 ft.

Electric power will be used wherever practicable, many of the machines being driven by separate motors, and the smaller machines in groups driven from shafting. Some of the large machines will be driven by separate steam engines. Compressed air will be piped throughout the plant to operate riveters, reamers, rivet furnaces, etc. Ground has already been broken and foundations are well under way. The President and General Manager of the company, W. P. Coleman, has offices at 529 Board of Trade Building, Montreal, assisted by N. S. Reeder.

Government Wireless Telegraphs.

Rear Admiral Manney, Chief of the Bureau of Equipment, U. S. Navy, in his annual report, says that during the last fiscal year 58 wireless telegraph stations have been installed on shore and on ships. A contract has been let for the installation on two lightships which relieve each other on Nantucket Shoal, the contract guaranteeing a chain of communication from the lightship to the torpedo station at Newport, R. I. The bureau hopes soon to put in additional stations to bring the communication direct to Washington. It is proposed to establish a time-signal station by wireless telegraph in connection with the Naval Observatory, and a wireless telegraph storm signal service in connection with the Weather Bureau. A contract has been made providing for long-distance stations with a maximum range of about 1,000 miles at Porto Rico, Guantanamo, Cuba, and the Panama Canal zone.

Railroad Freight to and from Mexico.

The statistics, published by the treasury department of Mexico, of freight carried by railroad across the Rio Grande frontier at Ciudad Juarez, Ciudad Porfirio Diaz, Laredo and Nogales shows the total traffic, both ways, between Mexico and the United States during the five fiscal years from 1898 to 1903 is as follows:

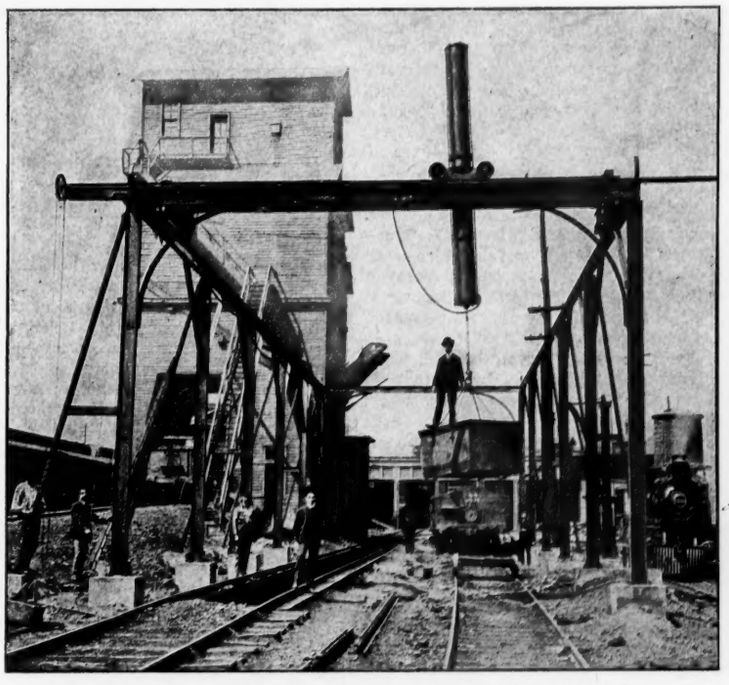
	Cars.	Tons.
1898-1899	47,811	756,251
1899-1900	72,063	888,503
1900-1901	58,997	759,360
1901-1902	51,437	627,025
1902-1903	56,116	902,472
Totals	286,424	3,933,611

The number of cars entering Mexico during the five years and six months from July 1, 1898, to Dec. 31, 1903, numbered 214,002, while 101,387 cars returned to United States, apparently leaving 112,615 cars now in Mexico, less those destroyed. The tonnage of merchandise moved is as follows:

3,277,706 tons entered Mexico;
1,153,216 tons exported from Mexico; or
2,124,490 tons of freight imported in excess of the tonnage exported.

Pneumatic Ash-Handling Plant.

The ash-handling plant shown in the accompanying illustration was built for the Baltimore & Ohio by the Northern Engineering Works, Detroit, Mich. It consists of a steel runway 95 ft. long, supported on steel columns securely braced against side laterally. On this runway is a 2½-ton direct-acting, air hoist traveling crane, of 28 ft. span and a lift of from 12 ft. to 16 ft. It is moved along the runway by means of hand chains and the travel of the trolley on the bridge is accomplished by the same means. The entire structure is designed to handle full loads with a factor of safety of five. The crane, bridge and trolley are fitted with "Northern" cage-type roller bearings and the wheels have machined treads to make the travel as easy as possible. The traveling chain on the bridge projects beyond the runway, but this chain can be located wherever desired on the bridge. The hoist is direct-acting and known as Type 20; it is mounted on a universal swing bearing on the trolley. The working pressure is 80 lbs., the air being conveyed to the hoist by hose, carried along the runway on small hose trolleys over which it is looped.



Pneumatic Ash-Handling Plant for the Baltimore & Ohio.

In operation, the ashes and cinders are dumped from the locomotive into large metal ash boxes in the ash pit. These boxes are lifted out by the crane and placed on a flat car alongside. The plant is cheap to build and to operate. If preferred the bridge and trolley can be moved by air motors, and for those roads having electric power, electrically operated plants can be supplied. These latter are more compact and efficient than the pneumatic plants. The builders supply the runway in any span and length desired, or the crane can be supplied alone, the buyer supplying the runway.

Manufacturing and Business.

At the St. Louis Exposition, the Norton Emery Wheel Co., of Worcester, Mass., was awarded two grand prizes and two gold medals for its exhibit.

The Baldwin Locomotive Works has been awarded a grand prize and five gold medals for its exhibits of locomotives and trucks at the St. Louis World's Fair.

The American-Panama Construction Co., of East Orange, has been incorporated in New Jersey with a capital of $500,000 to build railroads, etc., by Fred Lee Palmer, C. I. Geyer and F. C. Ferguson.

The Keller Machine Co., of New York, has been incorporated with a capital of $100,000 to make machinery by G. Keller, of New York City, and C. R. Schultz and C. W. Schults, of Murray Hill, N. J.

The Board of Directors of the Pressed Steel Car Co. have elected O. C. Galey Second Vice-President and put him in charge of the sales department. The office of Manager of Sales, Eastern district, is abolished.

The Cutler-Hammer Manufacturing Co., of Milwaukee, Wis., maker of electrical machinery, has given a contract to the Northern Electrical Manufacturing Co., of Madison, Wis., for a 75-k.w. and a 37.5-k.w. generator for equipping its new works.

The C. E. Hewitt Co., of Yonkers, has been incorporated in New York with a capital of $85,000 to conduct a general contracting and engineering business. The directors are: C. E. Hewitt and M. G. Hubbard, of Chatham, N. J., and H. A. Heyn, of New York City.

The bids opened by the Navy Department October 29 for the dry dock at Mare Island navy yard were as follows: The Scofield Co., New York, $1,385,000; W. N. Concannon, San Francisco, $1,420,000; Healy, Tibbits & Co., San Francisco, $1,387,000; Burrell Construction Co., Oakland, $1,645,000.

The Secretary of War last week rejected all of the seven bids for boilers for the new power plant at the West Point Military Academy, the lowest of which was from the Sterling Boiler Co., of Barberton, Ohio, at $30,600, and the next lowest from the Babcock & Wilcox Co., at $38,250. The Secretary has directed that new bids be asked for on plans and specifications, assuring a free competition.

The Wilmarth & Morman Company, Grand Rapids, Mich., maker of "New Yankee" drill grinders, reports recent shipments of these grinders to the Erie (five shops); El Paso & Southeastern, Douglas, Ariz.; Atlantic Coast Line, Richmond, Va.; Louisville & Nashville, Howell, Ind.; Santa Fe, Richmond, Cal.; Atlanta, Knoxville & Northern, Knoxville, Tenn., and Government Railroad, Cape Town, South Africa.

The Wildel Manufacturing Co., of Wilmington, Del., is being organized, with a capital of $100,000, to make and deal in railroad appliances. The company proposes to buy a plot of ground in Wilmington and build a foundry, machine shop, etc., in which the chief production will be Kennedy's perfected deflector car ventilator. There will be no promoters' stock or "ground-floor prices"; the stock is to be "waterless."

The Harlan & Hollingsworth plant at Wilmington, Del., of the United States Shipbuilding Co., the last one of that company to be disposed of, was sold at auction October 25 by James F. Winchell, acting under authority of the United States Court, to George R. Sheldon, of New York, the only bidder, representing the reorganization committee, at the minimum amount fixed by the court, $550,000 for the plant of the Harlan & Hollingsworth Co. and $135,000 for the material owned by the United States Shipbuilding Co.

The plant of the Chicago Tie Preserving Company now building at Paris, Ill., is nearing completion, and, it is expected, will soon be put in operation. This is the second plant established by this company during the past few months. The first one at Terre Haute, Ind., is now in operation, working with the zinc-tannin process, and has a capacity of about 30,000 ties a month. The output of the Paris plant will be about double this amount. There will be two treating retorts 6 ft. in diameter and 130 ft. long, using the zinc creosote process, which is said to be somewhat more expensive than the zinc-tannin process, but is believed to be better.

About 135,000 ft. (over 25 miles) of 1-in. steam pipe will be used in the hot-blast heating and tempering coils to be installed in the new Wanamaker building in Philadelphia. This pipe will be put up in 111 "ABC" heater sections varying in capacity from 3,500 to 56,000 sq. ft. of heating surface each. In connection with these heaters and in other parts of the building 28 "ABC" fans will be used, the largest having a housing 18 ft. high and the smallest 50 in. The completed apparatus, which is now being built by the American Blower Co., Detroit, Mich., will make a 10-carload shipment. "ABC" apparatus is also to be installed in the New York Wanamaker building. Some 44,000 ft. of 1-in. pipe will be used in the heaters and seven large fans will ventilate the building. This company has the contract for the heating apparatus for the roadway shops of the Philadelphia Rapid Transit Company. The company is now making heating and ventilating apparatus for 21 public buildings, 15 factories and seven schools in different parts of the United States.

Iron and Steel.

The Louisville & Nashville, it is reported, has ordered 50,000 tons of rails from the Tennessee Coal & Iron Co. instead of 20,000, as previously reported.

The increased demand for pig iron is causing the starting up of a number of furnaces in Cleveland and in the Mahoning and Chenango valleys that have been idle for many months.

The Pennsylvania's new foundry being built at South Altoona will be ready for operation in about two months. The wheel foundry is about finished. It will have a capacity of 900 wheels a day.

E. A. S. Clark has been elected President of the Lackawanna Steel Co. Mr. Clark will have his headquarters in New York. He was formerly with the Illinois Steel Co., and is now General Manager of the International Harvester Co.

The pig iron production of the United States Steel Corporation for the month of October will be approximately 600,000 tons, as compared with a monthly average of 606,603 tons throughout 1903 and 664,627 tons in 1902. In October, 1903, the production was only about 400,000.

Robert E. Jennings, receiver of the Carpenter Steel Co., of Reading, Pa., has filed his final report and the court has directed him to turn over the property to the reorganization committee. The plan is to form a new organization under the laws of New Jersey with an authorized capital of $1,200,000 and to issue $350,000 5 per cent. 50-year gold bonds redeemable after two years. Mr. Jennings will probably be the President. The excess of assets over liabilities on October 1 was $224,973, which the receiver says has been increased $29,052 since his appointment.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 24.)

Canadian Railway Club.

At the meeting of this club on November 1, the programme includes papers on "The Effects of Stress Upon Metals," by Dr. Coker, and "Thermit Welding," by W. Abbott.

American Society of Civil Engineers.

At the business meeting of this society November 2, James C. Meem described "a new method of tunneling as applied to the construction of the Bay Ridge sewer," with illustrations.

Association of Maintenance of Way Master Painters of the United States and Canada.

The first annual convention of this association, which was organized Dec. 8, 1903, will be held in the Hotel Marlborough, Broadway and 36th street, New York City, November 29 and 30. Engineers of maintenance of way of all railroads are invited to attend the meeting. The programme includes papers on Painting Signal Blades, Track Tanks, Signals and Iron Bridges. H. J. Schnell, 100 William street, New York, is Secretary.

American Society of Mechanical Engineers.

At the meeting of this society, to be held in New York December 6, 7, 8 and 9, the candidates presented by the nominating committee will be: John R. Freeman, Providence, R. I., for President; S. M. Vauclain, Philadelphia; H. H. Westinghouse, Pittsburg, and Fred W. Taylor, Philadelphia, for Vice-Presidents, and William H. Wiley, New York, for Treasurer. For Managers, the names of George M. Brill, Chicago; Fred J. Miller, New York, and Richard H. Rice, of Lynn, Mass., will be voted for. The opening session will be Dec. 6, at 9 p.m., at which the annual address will be given by the President, Ambrose Swasey. Wednesday morning, December 7, the session will be at 113 West Fortieth street, and papers will be presented on: "A New Hydraulic Experiment," by N. F. Nagle; "A Twist Drill Dynamometer," by W. W. Bird and H. P. Fairfield, and "Diamond Tools," by Gus. C. Henning. Thursday morning the following papers will be discussed: "Centrifugal Fans," by A. J. Bowie, Jr.; "Water Powers and Damages Caused by Diversion of Water," by Charles T. Main; "An Indicating Steam Meter," by Charles E. Sargent; "Stay Bolts, Braces and Flat Surfaces," by Robert S. Hale, and "Condensers for Steam Turbines," by George I. Rockwood. On Thursday evening the papers will be on: "Bursting of Four-foot Fly-Wheels," by Charles F. Benjamin; "Influence of the Connecting Rod Upon Engine Forces," by Sanford A. Moss; "Losses in Non-Conducting Engines," by James B. Stanwood; "Power Plant of Tall Office Buildings," by Sterling H. Bunnell; "Pressures and Temperatures in Free Expansion," by A. Bordody and R. C. Cairncross.

At the society house on Friday morning the following papers will be discussed: "Fuel Consumption of Locomotives," by George R. Henderson; "Road Tests of Brooks Passenger Locomotives," by E. A. Hitchcock; "Discharge of Water with Steam from Water Tube Boilers," by A. Bement; "More Exact Method for Determining the Efficiency of Steam Generating Apparatus," by A. Bement, and "Forcing Capacity of Fire Tube Boilers," by Francis W. Dean.

PERSONAL.

—Mr. R. H. Gilmour, Superintendent of the Brooks Works of the American Locomotive Company, at Dunkirk, N. Y., died suddenly at Schenectady on October 26.

—Mr. Henry Hawgood, whose resignation as Chief Engineer of the San Pedro, Los Angeles & Salt Lake, was recently announced, has resumed his former practice as Consulting Engineer, with office at Los Angeles, Cal.

—Mr. J. F. Maguire, who was until a few months ago Superintendent of the New York and the Greenwood Lake Divisions of the Erie and of the Northern of New Jersey and the New Jersey & New York railroads at Jersey City, N. J., has taken a position in the office of the Assistant to the President of the Lehigh Valley at New York city.

—Mr. Samuel G. Thomson, Assistant Master Mechanic of the Harrisburg shops of the Pennsylvania Railroad, is a graduate of Princeton University, class of 1898. In the fall of that year he entered the service of the Pennsylvania as a special apprentice in the shops at Altoona. Four years later he was made inspector, and the following year (1903) became foreman of the Bedford shops at State Line, Pa. Now Mr. Thomson is again promoted to be Assistant Master Mechanic at Harrisburg.

—Mr. William H. Keffer, the new Assistant to the General Superintendent of the Philadelphia & Reading, was born at Frackville, Pa., and is 41 years old. He has been in the service of this company for the past 24 years, starting as a telegraph operator; and he has been successively ticket seller, coal and shipping clerk, train despatcher, car agent, traveling despatcher, yardmaster, assistant trainmaster and trainmaster, from which latter position he is now promoted to be Assistant to the General Superintendent at Reading.

—Mr. LeGrand Parish, whose promotion to be Assistant Superintendent of Rolling Stock of the Lake Shore & Michigan Southern has been announced, has for a number of years been Master Car Builder at Englewood, Ill.

His railroad career began on the Lake Shore. He began as a storekeeper at Adrian, Mich., in 1891. Three years later he went to Englewood, where he became chief clerk in the car department. From that position he was promoted to be General Foreman, then Master Car Builder of the Western Division. In July, 1900, Mr. Parish's jurisdiction was extended over the Michigan Division. In his new position his headquarters will be at Cleveland.

—Mr. George D. Brooke, formerly Superintendent of Machinery and Equipment of the Iowa Central, and the Minneapolis & St. Louis roads, has been appointed a member of the Engineering Staff of the Panama Canal Commission; the appointment took effect October 20. Mr. Brooke intends to start for the Isthmus on November 18. His exact duties have not as yet been fully defined and will not be until his arrival at the Isthmus.

—Mr. James C. Cassell, Assistant to the President of the Norfolk & Western, has resigned to engage in other business. Mr. Cassell's vacation, which he took in 1903 on account of impaired health, did not fully restore him and he has now been obliged to take up work of a less exacting nature than that of his railroad position. Mr. Cassell's railroad service has extended over 35 years, a third of which was spent on the Pennsylvania. On the Norfolk & Western, where he has been for about a quarter of a century, he began as a train despatcher.

—Mr. C. L. Hilleary, who a few months ago resigned his position with the Cleveland, Cincinnati, Chicago & St. Louis to become Traffic Manager of the World's Fair at St. Louis, has resigned that place and returned to the Big Four. He will be Chief Assistant General Passenger Agent, with headquarters at St. Louis. Mr. Hilleary began his railroad service as a brakeman on the Norfolk & Western. Mr. Deppe, who took Mr. Hilleary's place last spring, has resigned to engage in business in New York. The new Traffic Manager of the World's Fair is Mr. J. M. Allen.

—Mr. Frederic Methven Whyte, whose jurisdiction now extends over the New York Central & Hudson River, the Boston & Albany, the Lake Shore & Michigan Southern, the Lake Erie & Western, and the Indiana,

Illinois & Iowa, with the title of General Mechanical Engineer, is 39 years old. He graduated from Franklin Academy in 1884 and Sibley College, Cornell University, in 1889. In the summer of that year Mr. Whyte entered the service of the Lake Shore as a draftsman in the motive power department. The next year he resigned and went to the Baltimore & Ohio, where for about two years he was in the testing department. In 1892 he went to Mexico to do special testing for the Mexican Central, but in June of that year returned and went to Chicago, where he was connected with the South Side Elevated. In 1897 he was appointed Mechanical Engineer of the Chicago & North Western and Secretary of the Western Railway Club. In 1899 he was appointed to be Mechanical Engineer of the New York Central at New York city, from which position he is now promoted to be General Mechanical Engineer. Mr. Whyte was at one time (1892) a member of the editorial staff of the *Railroad Gazette* in Chicago.

—Mr. Frederick W. Brazier, whose title has been changed from Assistant Superintendent of Rolling Stock to Superintendent of Rolling Stock of the New York Central & Hudson River, with jurisdiction over the Boston & Albany, is a native of Boston, Mass., and is 52 years old. His first railroad position

was on the Fitchburg in 1877, where he went to work as a carpenter and assistant foreman. Then for eight years he was general foreman; then, for three years, from 1893, Mr. Brazier was Superintendent of the Chicago, New York & Boston Refrigerator Company at Chicago. For about nine months he was in the car department of the Illinois Central as general foreman, and in October, 1896, was appointed to be Assistant Superintendent of Machinery. In June three years later he returned to New York city as Assistant Superintendent of Rolling Stock of the New York Central, from which position he is now promoted as above.

—Mr. Cornelius Shields, General Manager of the Lake Superior Corporation, died suddenly at Sault Ste. Marie, on October 28, at the age of 48. Mr. Shields was a native of Albany, N. Y., and was a well known railroad man. He had been in the service of the Southern Minnesota (Chicago, Milwaukee & St. Paul), the Canadian Pacific, the St. Paul, Minneapolis & Manitoba and other railroad companies for many years. He was at one time General Superintendent of the Western Division of the Great Northern, and in 1899 was elected Vice-President and General Manager of the Virginia Southwestern Railway and the Virginia Iron, Coal & Coke Company.

—Mr. John Howard, who on Tuesday last went from Boston to New York city to become Superintendent of Motive Power of the New York Central & Hudson River and leased lines, including the Boston & Albany, has been in railroad service for the past 32 years. He began on the Pennsylvania Railroad as a machinist

apprentice at Renovo. In 1883 he went to Kingston, N. Y., and took a similar position on the West Shore. He was soon made engine inspector and served in that capacity until 1884, when he went to Frankfort as foreman of engine house. Seven years later he was appointed General Foreman and in 1892 was promoted to be Master Mechanic of the River Division of the West Shore at New Durham, N. J. Here he served as Master Mechanic until 1901, when he was made Division Superintendent of Motive Power and Rolling Stock of the Pennsylvania Division of the New York Central at Corning, N. Y. The following year he was transferred to Depew as Division Superintendent of Motive Power of the Western Division, and in May of this year was called to Boston to be Superintendent of Motive Power and Rolling Stock of the Boston & Albany.

ELECTIONS AND APPOINTMENTS.

Annapolis, Washington & Baltimore.—W. E. Slaughter, hitherto Acting Auditor, has been appointed Traffic Manager and General Superintendent, succeeding A. E. Shaver.

Canadian Pacific.—Grant Hall, hitherto Assistant Superintendent of Rolling Stock of the lines east of Fort William, has been appointed Assistant Superintendent of Motive Power for the western lines, with headquarters at Winnipeg, Man.

Cincinnati, Hamilton & Dayton.—J. A. Gordon, Superintendent of the Southern Division, has been appointed General Superintendent, succeeding R. B. Turner, resigned. The jurisdiction of S. B. Floeter, Superintendent of the Northern and Fort Wayne Divisions, has been extended over the Southern Division. The jurisdiction of C. E. Vorhis, Superintendent of the Wellston Division, now includes the Delphos Division. Mr. Vorhis succeeds W. W. Harring, resigned. George H. Graves, Superintendent of the Springfield Division, has resigned, and W. C. Shoemaker, Superintendent of the Indianapolis Division, has assumed the duties of that office.

J. S. Lazarus, Assistant General Freight and Passenger Agent, has resigned.

Cumberland Valley.—J. B. Diven, hitherto Assistant Master Mechanic of the Pennsylvania at Verona, Pa., has been appointed to a position in the office of the Vice-President and General Superintendent of the C. V., with headquarters at Chambersburg. In his new position Mr. Diven will do special work and will have supervision over motive power matters.

Denver & Rio Grande.—F. A. Wadleigh has been appointed Assistant General Passenger Agent, with headquarters at Denver, Colo. S. K. Hooper, General Passenger Agent, has been granted leave of absence for about six months.

Evansville & Terre Haute.—E. H. Pfafflin, Superintendent and Chief Engineer, having resigned, J. S. Douglas has been appointed Superintendent in charge of transportation, with headquarters at Evansville, Ind.

Indiana, Illinois & Iowa.—J. T. Flavin has been appointed Assistant Master Mechanic, in charge of all matters pertaining to the locomotive department, with headquarters at Kankakee, Ill., succeeding Peter Maher, resigned. George Thomson has been appointed General Foreman at Kankakee, Ill., in charge of the car department.

See Lake Shore & Michigan Southern.

Lake Shore & Michigan Southern.—I. S. Downing has been appointed Master Car Builder of the Michigan Southern Division of the L. S. & M. S., with jurisdiction over the Indiana, Illinois & Iowa, with headquarters at Englewood, Ill., succeeding L. G. Parish, promoted. T. H. Goodnow has been appointed to succeed Mr. Downing as General Foreman of the L. S. & M. S., at Air Line Junction, Ohio.

Midland Valley.—C. H. Welch, hitherto Master Mechanic of the Mississippi Central, has been appointed Master Mechanic of the M. V., with headquarters at Fort Smith, Ark.

Mississippi Central.—See Midland Valley.

Panama.—George W. Davis, Frank J. Hecker and Benjamin M. Harrod, members of the Isthmian Canal Commission, have been elected Directors.

Pennsylvania.—See Cumberland Valley.

Philadelphia & Reading.—F. F. Gaines has been appointed Mechanical Engineer, with office at Reading, Pa.

Seaboard Air Line.—J. R. Bissett has been made Master Mechanic at Raleigh, N. C. F. P. Hickey was formerly Master Mechanic at that point.

Southern Pacific.—W. H. Bancroft, Vice-President and General Manager of the Oregon Short Line, has been appointed Acting General Manager of the S. P., succeeding C. H. Markham, General Manager, resigned.

Stony Creek.—George F. Baer has been elected President, succeeding the late James Boyd.

Rutland.—Robert T. Paine, 2d, has been elected a Director, succeeding George H. Ball.

Toledo, Peoria & Western.—E. F. Leonard, President and Treasurer, has resigned.

Toledo, St. Louis & Western.—J. E. Mathers has been appointed Superintendent of Telegraph, with headquarters at Frankfort, Ind., succeeding F. P. Lapham, resigned.

LOCOMOTIVE BUILDING.

The Grand Trunk has ordered 25 Mogul (2-6-0) locomotives from the Canadian Locomotive Co. at Kingston, Ont.

The Canadian Pacific, some two years ago, gave an order to the Canada Foundry Co., Ltd., of Toronto, Ont., for a few freight engines. The first of the lot and the first modern locomotive to be built in Toronto has just been turned out.

CAR BUILDING.

The Central of New Jersey has ordered 30 passenger coaches from Barney & Smith.

The Louisville & Nashville is reported about to build 1,000 freight cars at its own shops.

The Chicago, Milwaukee & St. Paul denies

having ordered dining cars from Barney & Smith.

The Oak Ridge Coal & Coke Company is having 50 freight cars built at the McKees Rocks Works of the Pressed Steel Car Co.

The American Cotton Oil Company is having 50 freight cars built at the Berwick Works of the American Car & Foundry Co.

The Chicago, Rock Island & Pacific, as reported in our issue of October 28, is considering the purchase of three postal cars.

The Chicago, Burlington & Quincy, as reported in our issue of October 28, has ordered 100 box cars of 80,000 lbs. capacity from the Pullman Co.

The Illinois Central, as reported in our issue of October 28, has ordered 500 steel underframe box cars of 80,000 lbs. capacity from the American Car & Foundry Co.

The Intercolonial has ordered 100 flat cars, 50 box cars and 10 coaches from Rhodes, Curry & Co., Amherst, N. S., and 50 box cars and 16 passenger coaches from the Crossen Car Co., Cobourg, Ont.

The Chicago, Indianapolis & Louisville, as reported in our issue of October 28, is about to let contracts for 750 36-ft. box cars of 80,000 lbs. capacity. It is reported that this order will go to Haskell & Barker.

The Chesapeake & Ohio has ordered 22 cabooses from the American Car & Foundry Co., for December and January delivery. These cars will weigh 21,500 lbs., and measure 17 ft. 5 in. long, 7 ft. 10 in. wide and 6 ft. 8¼ in. high.

The Pennsylvania has ordered 2,400 steel self-clearing coal cars and 200 coke cars from the Pressed Steel Car Co.; 1,500 gondolas with steel underframes and wooden sides and 700 box cars from the American Car & Foundry Co.; 500 coke cars from the Cambria Steel Car Co., and 1,500 gondolas with steel underframes and wooden sides from the Standard Steel Car Co., a total of 6,800 cars.

BRIDGE BUILDING.

ANSON, WIS.—A steel bridge, it is reported, will be built by this town over the Chippewa River to cost about $10,000.

BENTON HARBOR, MICH.—The Board of Supervisors, at a recent meeting, decided to rebuild jointly, with St. Joseph township, the Napier bridge, at a cost of about $22,000.

CHILLICOTHE, MO.—Bids are wanted November 15 by the Bridge Commissioner at the office of the County Clerk for two large iron bridges. J. Y. Powell is County Surveyor.

CLINTON, N. DAK.—Bids are wanted November 11 by G. A. Herolz, Auditor, for building a low-truss steel bridge 66 ft. long over Beaver creek, in Emmons County, near Exeter.

COLDSPRING, N. Y.—Plans, it is reported, are being made for a single span steel bridge 290 ft. long to be built over the Seneca river, in Putnam county, at a cost of about $20,000.

DILLAN, MONT.—Bids are wanted by J. S. Baker, County Clerk, December 5, for build a bridge with two 65 ft. spans over Big Hole River.

EVANSVILLE, IND.—Bids are wanted November 17 by the Board of County Commissioners for building eight steel bridges in Vanderburg County. Henry Stinson is County Auditor.

FORT WILLIAM, ONT.—The Board of Trade favors building a steel bridge over the Kaministikwia River.

HANNIBAL, MO.—A bridge is proposed to be built over the Mississippi river at this place for the use of the new electric road to be built between this place and Quincy.

GUTHRIE, OKLA. T.—The County Commissioners are having surveys made for building a new bridge 35 ft. wide over the Cimarron river.

KNOXVILLE, TENN.—An ordinance has been passed by the Board of Aldermen and signed by the Mayor requiring the Knoxville, La-Follette & Jellico Railroad and the Southern to jointly build a bridge or viaduct with approaches over the tracks at Clinch avenue.

MILWAUKEE, WIS.—According to local reports, the Chicago, Milwaukee & St. Paul has offered to pay the city $125,000 towards the cost of a new viaduct at Sixth street and First avenue.

The Finance Committee has under consideration a resolution to build a bridge over the Kinnickinnic at an avenue of the same name, to cost about $125,000.

MONROE, LA.—Bids are wanted November 15 by the Police Jury for building two steel bridges over Bayou Boeuf. C. H. Peevy is a member of the Police Jury.

MONTGOMERY, ALA.—Bids are wanted November 12 by George E. Mattice, Treasurer of the Montgomery Bridge Co., for building a steel toll bridge over the Alabama River.

MOUNT VERNON, IND.—Bids are wanted November 9 by the Board of County Commissioners for building two steel bridges in Robinson Township. S. G. Howard is County Auditor.

MUSKEGON, MICH.—The Board of Supervisors have under consideration the question of building a bridge over the Muskegon river at Bridgeton to connect Muskegon and Newaygo counties. It will be necessary for the legislature to pass a bill allowing the two counties to raise the necessary money before work can be commenced.

ST. JOHNS, ORE.—The Northern Pacific, reports say, is making surveys for a line into this town. The work includes the building of a bridge about 180 ft. above the surface of the Willamette river.

SEYMOUR, IND.—Bids are wanted November 7 by Asburg H. Manuel, Auditor of Jackson County, for building a steel bridge 16 ft. wide and 40 ft. long; also for repairing a steel bridge over Indian creek near Cortland.

SPENCERVILLE, ONT.—Bids are being received by the Township Clerk for building an iron and also a steel bridge over the Nation river.

STATENVILLE, GA.—Bids, it is reported, are being asked November 8 by G. W. Prince, County Clerk, for building a steel bridge over the Allapaha River.

SUPERIOR, WIS.—The City Council has been petitioned by residents to build a bridge over the Nemadji River at Grand avenue.

TOLEDO, OHIO.—Bids will soon be asked by Lucas County Commissioners for building bridges in Sylvania and Washington townships. D. F. Davies, Jr., is County Auditor.

WASHINGTON, D. C.—The commissioners have approved the plans of the Philadelphia, Baltimore & Washington for its railroad bridge over Water street.

Plans are being considered for the New York avenue bridge, which will be 500 ft. long, carrying that avenue over the proposed series of tracks in the Eckington yards; the estimated cost is $150,000. In connection with the proposed changes in the T street bridge, it is said that the railroad company wishes to build a bridge 24 ft. wide instead of 30 ft. The T street bridge is to be about 650 ft. long and will cost $175,000.

Other Structures.

BRIGHTWOOD, IND.—The Cleveland, Cincinnati, Chicago & St. Louis shops at Brightwood, according to local reports, will be rebuilt and a large amount of new machinery added. One-half of these shops were built about a year ago and the new work is to complete the rebuilding of the remainder.

CHARLOTTE, N. C.—The Southern Railway has decided to build a new passenger station at a cost of about $55,000, instead of remodeling the present structure, as originally intended.

CHATTANOOGA, TENN.—The Cincinnati, New Orleans & Texas Pacific, local reports state, has plans ready for a three-story building 125 x 334 ft. for railroad shops, to be equipped with three 80-ton cranes and three turntables. The improvements will cost about $200,000. The railroad has not definitely decided whether the shops will be located at Chattanooga or at Somerset, Ky.

CINCINNATI, OHIO.—The Cincinnati, New Orleans & Texas Pacific has asked for the vacation of Elm street and Gilmore alley from the south line of Commerce street to the north line of Water street for its new freight house.

The Louisville & Nashville has asked for the vacation of Race and Elm streets from the south line of Water street to the Ohio River as a site for its new station.

CRETE, NEB.—The Chicago, Burlington & Quincy is building a brick and stone station 35 ft. wide and 177 ft. long to cost about $16,000.

DETROIT, MICH.—The Michigan Central, Grand Trunk and Lake Shore, reports say, have agreed to jointly build a union passenger station at Grand River and Warren avenues.

DOUGLAS, ARIZ.—The El Paso & Southwestern is receiving bids for building a steel frame machine shop 142 x 244 ft. one story high, with curtain walls of brick, on which work is to be commenced next month. F. B. Wilson is engineer in charge.

GOLDSBORO, N. C.—The Atlantic & North Carolina, according to local reports, will establish repair shops at this place.

MATTOON, ILL.—The Cleveland, Cincinnati, Chicago & St. Louis, reports say, will build a new roundhouse at this place.

MOBILE, ALA.—Bids are wanted December 10 by the Southern Railway at Atlanta, Ga., for building a union passenger station at Mobile 195 x 150 ft., to cost about $100,000. The general waiting room will be 60 x 60 ft., ladies' waiting room 60 x 40 ft., and colored waiting room 60 x 40 ft. The building is to have an independent electric light plant.

The Mobile & Ohio, local reports state, will make extensive improvements to its terminals here, to include wharves, with two-story warehouses.

NASHVILLE, TENN.—The Nashville, Chattanooga & St. Louis, reports say, has given a contract to C. N. Rives for building a new freight house to replace the one recently destroyed by fire.

PICTOU, N. S.—The Dominion Government has given a contract to Rhodes, Curry & Co., of Amherst, N. S., for building a station here at about $40,000; also for building one at Antigonish at $12,000.

PITTSBURG, PA.—Local reports state that the McClintic-Marshall Construction Co. has been given a contract by the Wabash at $200,000 for building its freight station. About 4,000 tons of steel will be used in its construction, which is to be rolled at the finishing mills of the Jones & Laughlin Steel Company.

PORTLAND, ORE.—The Northern Pacific Terminal Co. is making plans and will soon ask bids for building umbrella train sheds 2,000 ft. long, in two sections of 1,000 ft. each, with asphalt floors. E. Lyons is Manager.

PUEBLO, COLO.—The Denver & Rio Grande will build, with the company's forces, on which work will be commenced about November 10, a 26-stall brick roundhouse with composition roof. The only contracts in connection with the work will be for the installation of steam heat.

SEATTLE, WASH.—The Columbia & Puget Sound Railroad, reports say, is having plans made for a passenger station to be located at Washington and Main streets.

WASHINGTON, D. C.—Several tentative plans for the proposed extension of the central portion of the east front of the Capitol have been prepared, which, it is expected, will be turned over to a Commission of the leading architects of the country after having been first submitted to the Joint Commission of Congress. The architects who are

preparing the plans, Messrs. Carrere & Hastings, have suggested that after a plan is selected the work be done first in staff so that the effect can be seen before the final change is made. This suggestion has been favorably received and endorsed by other architects and it is probable that Congress will be asked to appropriate $100,000 for this temporary structure.

WATERLOO, IOWA.—The Chicago & North Western, reports say, will build a passenger station to replace the present structure.

WINONA, IND.—According to press reports, the Pennsylvania will spend $25,000 in improvements at this place, including a new passenger station.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATLANTA, KNOXVILLE & NORTHERN.—An amendment to the charter of this company has been filed, providing for the building of a branch line from a point near Cambria, in McMinn County, Tenn., southwest through McMinn, Bradley and Polk counties in Tennessee, to Cartersville, Ga., 60 miles. It is stated that work in this line will soon be begun.

AUGUSTA & FLORIDA.—This company has applied for a charter in Georgia to build a line from Augusta to Midville, 60 miles. Connection will be made with the Central of Georgia at Midville. W. M. Blount, Union Spring, Ala.; J. T. Davis, Midville, Ga.; C. C. Howard, Augusta, Ga., and others are interested.

BINGHAMTON & SOUTHERN.—See New York, Pennsylvania & Southwestern below.

CANADIAN VALLEY & WESTERN.—This company, which was recently chartered in Oklahoma Territory, proposes to build from Coalgate, Ind. T., to Clinton, Okla. T., 160 miles. The line as projected will run through Tupalo, Purcell, Chickasaw and Weatherford. Surveys have been completed between Tupalo and Ada, Ind. T., 25 miles, and other surveys are now being run from Ada to Chickasaw, 85 miles. The maximum grade is .6 per cent. and the maximum curvature 4 degrees. D. Carter, Purcell, Ind. T., is President, and R. L. McWillie, Chief Engineer. (September 30, p. 110.)

CAYUGA LAKE & ITHACA.—Incorporation has been granted this company in New York to build a railroad from Ithaca to Ludlowville, 7½ miles. The authorized capital is $80,000. J. W. Wright, Dryden, N. Y.; E. A. Dender, Ithaca, N. Y., and others are incorporators. The project is said to have been started in the interest of the D., L. & W.

CHICAGO, BURLINGTON & QUINCY.—The new main line from Creston, Iowa, west to Pacific Junction, 70 miles, was opened for traffic October 30, though the second track is not entirely completed.

CHICAGO, MILWAUKEE & ST. PAUL.—Press reports state that this company has begun to rebuild its Sioux City & Dakota division from Manila to Sioux City, 90 miles. Grades will be reduced and the track will be laid with heavier rails and reballasted.

KANSAS CITY, OKLAHOMA & HOUSTON.—Grading is in progress on this proposed road between Honey Grove, Tex., and the Red river, 22 miles. Contracts for grading 84 miles from the Red river to a point in Indian Territory on the Choctaw, Oklahoma & Gulf will be let within the next two months. The maximum curvature is 4 degrees and the maximum grade .8 per cent. M. J. Smith, South McAlester, Ind. T., is Chief Engineer. B. P. Beam, Kansas City, Mo., is President. (September 2, p. 79.)

MISSOURI, OKLAHOMA & GULF.—Articles of incorporation have been filed by this company in Oklahoma Territory. It is proposed to build a railroad from Shawnee to a point in the northeastern part of Indian Territory. The authorized capital is $10,000,000. William Kenefick, Kansas City, Mo.; J. C. McNeal and M. L. West, Guthrie, Okla. T., and others are incorporators.

MONROE & SOUTHWESTERN.—Press reports state that work is now in progress on this proposed railroad from Monroe, La., southwest through Winfield to Natchitoches, about 85 miles. Fifteen miles have been graded and track has been laid for a distance of nine miles out of Monroe. The road is being built in the interest of the Monroe Lumber Co. W. A. Brown is Vice-President and General Manager and Robert Blanks Secretary, both of Monroe, La.

NEW YORK & JERSEY (HUDSON RIVER TUNNEL).—According to recent reports, the south tunnel of this company under the Hudson River is now about half completed. The north tunnel was driven through last March. Work is also progressing rapidly on the excavations leading to the terminal at Greenwich street. It is expected that if the work progresses as rapidly as it has already done, and if no large amount of rock is encountered, the tunnel will probably be finished early next year.

NEW YORK, PENNSYLVANIA & SOUTHWESTERN.—It is reported that this is the new name of the former Binghamton & Southern, which was chartered to build a railroad from Williamsport, Pa., northeast to Binghamton, N. Y., 116 miles. A contract for building the line has been let to Rogers & Co., 15 Wall street, New York City. D. E. Baxter, 277 Broadway, New York, is General Manager. (October 28, p. 139.)

PAN-AMERICAN.—This railroad, which has hitherto been owned by Nebraska capitalists, has now passed into the hands of a St. Louis syndicate. D. H. Doak, St. Louis, is the new President, and J. M. Neeland Vice-President. The main portion of the line, extending from San Geronimo, on the Tehuantepec National, to the Port of Tonala, in the state of Chiapas, Mex., 125 miles, was opened for traffic on November 1. It is proposed to eventually extend the line to Guatemala.

PENNSYLVANIA.—H. S. Kerbaugh & Co., Philadelphia, have been awarded a contract for excavating about 2,000,000 cu. yds. of earth on the low-grade division of the Pennsylvania between Columbia and the main line. Work on this section was stopped last year when the company began its retrenchment policy. It is stated that work on a number of other minor improvements will be begun very shortly.

PORTLAND CONSOLIDATED RAILROAD.—Articles of incorporation have been filed by this company in Oregon with an authorized capital of $5,000,000. The company is empowered to build an electric railroad from Portland to Vancouver and to take over the lines heretofore owned and operated by the Portland Street and the City & Suburban railway companies. J. C. Ainsworth, C. A. Dolph, A. L. Mills and others, of Portland, Ore., are named as incorporators.

ROCKDALE, JOLIET & LOCKPORT.—According to press reports, rights of way have been secured for this road between Rockdale, Ill., and Lockport. Contracts for grading are reported let and it is stated that work will be begun at once. Frederick Bennett, Joliet, Ill., is President. (May 13, p. 376.)

ROCKDALE, MOMENCE & SOUTHEASTERN.—This company has been incorporated in Illinois to build a railroad from Rockdale, in Will County, south to Momence, in Kankakee County, and thence to a point on the State line between Illinois and Indiana. J. W. Murdock, F. A. Jackson, C. E. Robinson and others, of Joliet, Ill., are incorporators.

ST. LOUIS, IRON MOUNTAIN & SOUTHERN.—Announcement is made that the Farmerville & Southern branch of this road, running from Farmerville, La., north to Felsenthal, Ark., 28 miles, has been opened for traffic.

WAYNESBORO & SAVANNAH VALLEY.—Application is about to be made for a charter for this company to build a railroad from Waynesboro, Ga., through Sylvania, Mill Haven and Bevell to Clyo, about 60 miles. Connection will be made with the Seaboard Air Line at Clyo. W. A. Wilkins, Jr., F. M. Kates, W. H. Davis, G. O. Warnock and others, of Waynesboro, Ga., are interested.

RAILROAD CORPORATION NEWS.

ATLANTIC COAST LINE.—This company has purchased the Macon, Dublin & Savannah, which runs from Macon, Ga., to Vidalia, 92 miles. The terms of the sale have not been made public.

BUFFALO CREEK.—Spencer, Trask & Co., Bankers, New York, are offering for sale a block of consolidation mortgage 5 per cent. gold bonds due Jan. 1, 1941; authorized issue, $1,000,000; outstanding, $645,000. The interest on the funded debt of the company and the 7 per cent. dividends upon the capital stock are guaranteed jointly by the Erie and the Lehigh Valley. The company owns a frontage of about 2,300 ft. upon the lake, where a ship canal 1,800 ft. long has been excavated. The road earns a surplus above fixed charges and guaranteed dividends.

BUFFALO & SUSQUEHANNA.—The tenth annual report of this company, for the fiscal year ending June 30, includes a detailed statement of the progress of the work on the company's new lines. Towards the south, the road has been extended 55 miles, opening up coal properties owned by the company or allied corporations at Medix Run, Tyler, Dubois and Sykesville. This line to the coal fields has been built under the charter of the Susquehanna & Southern, but it is expected that this company will be consolidated with the Buffalo & Susquehanna on or before January 1, 1905. A further extension south through the coal lands of the Buffalo & Susquehanna Coal & Coke Co. between Sykesville and South Bend, 50 miles, is now in contemplation. Surveys for this line have been practically completed and estimates prepared. Gross earnings for the year were $962,696, a decrease of $38,056. Operating expenses were $635,500, an increase of $67,207, leaving a decrease in net of $105,263.

BUFFALO, ROCHESTER & PITTSBURG.—The stockholders will vote on November 21 in New York and on November 28 at Ridgway, Pa., on the proposition to issue $3,000,000 additional capital stock to provide for the completion of the Indiana branch. This stock will be offered for subscription to shareholders in such amounts as may be necessary on account of capital expenditures. In the recent report of the company for the fiscal year ending June 30, it was stated that the cost of the Indiana branch had exceeded by $436,715 the proceeds of the $2,000,000 of common stock issued to pay for it. Further payments made during the three months ending September 30 have increased this to $498,648. The proceeds from the sale of the new stock issue will be used to provide for this excess and for other capital requirements.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA.—At the recent meeting of the stockholders the purchase of the Chippewa Valley & Southwestern and the Eau Clair, Chippewa Falls & Northeastern railroads was authorized. The two companies control a mileage of about 95 miles of road.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC.—The report of this company for the fiscal year ending June 30 shows gross earnings of $6,768,744, an increase of $613,289. Operating expenses increased $521,884, leaving an increase in net earnings of $91,406. Notwithstanding this increase in net, after subtracting all fixed charges and dividends, the balance carried to the credit of profit and loss was $80,528 less than in 1903. This was due to an increase of $80,225 for additional tracks charged to

income and an increase of $67,284 in the rental paid to the city of Cincinnati.

Georgia, Florida & Alabama.—A mortgage for $1,000,000 has been filed by this company with the Manhattan Trust Co., of New York. The proceeds from the sale of the mortgage will be used for building an extension from Cuthbert, Ga., north to Atlanta.

Georgia Southern & Florida.—The report of this company for the fiscal year ending June 30 shows gross earnings of $1,693,541, an increase of $58,350. Operating expenses were $1,278,464, an increase of $44,062, leaving an increase in net earnings of $14,288. A decrease of $10,262 in freight earnings was more than offset by increases of $40,723 and $25,352 respectively from passenger traffic and from miscellaneous sources. After deducting all fixed charges and interest, the balance carried over to the credit of the profit and loss account was $533,325.

Macon, Dublin & Savannah.—See Atlantic Coast Line.

New York, New Haven & Hartford.—See New York, Ontario & Western below.

New York, Ontario & Western.—It is announced that the New York, New Haven & Hartford at a meeting of its directors on October 26, all but two being present, voted to accept an option offered by Kuhn, Loeb & Co., on a majority of the New York, Ontario & Western stock. The price paid is $45 a share ex-dividend, and all the arrangements for the temporary financing extending over some months have been made. Taking for granted that the New Haven acquired a majority of the stock of the N. Y., O. & W. at $45 per share, the control cost a trifle over $13,300,000. If this amount is to be borrowed in the open market at say 3½ per cent. the increased charge against the New Haven will be about $465,000 a year; but, of course, the New Haven directors expect that the earnings of the O. & W. will provide for this. The question of a lease of the Ontario & Western on the basis of 1½ per cent. on the stock for five years, rising to 2 per cent. at periods of five years thereafter was considered. But as it was found that this plan required the assent of the New York Central, it was dropped. It is probable, however, that the New York, New Haven & Hartford Railroad Co. will make provision for the minority holders of the Ontario & Western Co. on a basis representing about $40 per share of stock. But whether the New Haven Company will raise money by debenture bonds or by stock is a matter yet to be determined. By the purchase the New Haven acquires about 500 miles of road, of which some 150 miles from Cornwall west is now being double-tracked. The roadbed is in excellent condition and the rolling stock sufficient for present business. From Cornwall to Weehawken the road has trackage rights over the West Shore under a contract which has about 175 years to run. The New Haven people hope to reach out to many independent coal corporations in the anthracite regions, largely to increase the coal business of the O. & W. Other facts about this purchase will be found in the editorial columns.

Oregon Short Line.—Formal notice has been issued by this company of its purpose to redeem all its 4 per cent. and participating 25-year gold bonds which may be outstanding on February 1, 1905, at 102½. The total issue amounts to $82,491,000, of which $36,500,000 is outstanding, the remaining $45,991,000 being in the treasury of the Union Pacific. Kuhn, Loeb & Co. are offering to exchange for each bond called for redemption on February 1, 1905, a temporary certificate of the Oregon Short Line for the $1,000 Oregon Short Line 4 per cent. refunding 25-year gold bonds, principal and interest to be guaranteed by the Union Pacific. The new bonds are to be dated December 1, 1904, and to bear interest semi-annually at the rate of 2 per cent. The total amount to be issued will be $40,000,000. These refunding 4s will have the guarantee of the Union Pacific. By the adjustment proposed those who make the exchange will in effect receive the new guaranteed bonds at 96 and accrued interest.

Pacific Coast.—The report of this company for the fiscal year ending June 30 shows gross earnings of $5,902,972, an increase of $296,218. Expenses increased $323,168, leaving a decrease in net of $26,948. The surplus for the year was $353,114, a decrease of $15,073. The total surplus of the company is now $1,710,677. The report tells of the purchase by the company of the Black Diamond coal mine, in the State of Washington. The increase in operating expenses is largely due to the operating expenses of renewals, formerly paid for from a special fund provided for the purpose.

Pennsylvania.—The gross earnings of the lines directly operated for the month of September show a decrease of $292,100. Operating expenses decreased $550,000, leaving an increase in net earnings of $257,900. On the Lines West of Pittsburg, there was a decrease of $139,700 in gross earnings, a decrease of $478,100 in operating expenses and an increase of $338,400 in net earnings, making an increase in net for the month on the entire system of $596,300.

Penobscot Central (Electric).—This road was sold at auction on November 1 to C. E. Fisher, of Gloucester, Mass., for $175,000. The road runs from Bangor, Me., to Hudson, 25 miles, and was built in 1898. It is operated by electricity and a year ago defaulted interest on its bonds of $250,000.

Public Service Corporation.—The directors of this New Jersey company have authorized an issue of $7,250,000 5 per cent. collateral trust notes due Nov. 1, 1909. These notes will be subject to call on any interest date on 60 days' notice at 102½ and interest. The Fidelity Trust Co., Newark, N. J., will act as trustee. The proceeds from the sale will be used for refunding purposes and for improvements to property. The notes are secured by $11,500,000 bonds of subsidiary companies. The entire issue has been purchased by the banking firms of Robert Winthrop & Co. and J. W. Seligman Co., of New York, and Lee, Higginson & Co., of Boston, and is being offered by these three firms for sale at 98 and interest.

Reading Company.—Notice has been given by the voting trustees of the Reading Co. that on and after December 1 no more voting trust certificates will be issued. From that date, holders of the present voting trust certificates are requested to present their certificates at the office of J. P. Morgan & Co., New York, and certificates of stock of the Reading Company will be delivered in exchange for the same. The voting trust expired on September 9 when a second dividend of 2 per cent. was paid on the first preferred stock.

St. Louis Southwestern.—Announcement is made that this company has sold $1,500,000 of its 4 per cent. first consolidated mortgage bonds of 1902. Of the $25,000,000 authorized, $6,000,000 was issued to retire equipment notes, $9,000,000 to retire by exchange the $10,000,000 second-mortgage income bonds, and the remaining $10,000,000 was reserved for the acquisition and construction of branch lines.

Terre Haute & Indianapolis—The receivership of this road was terminated on November 1. V. T. Malott, the receiver, will continue in charge of the road, however, as an officer of the company. The receivership was instituted in November, 1896, but has now been dissolved, as all litigation has been finally settled. (October 7, p. 120.)

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EDITORIAL ANNOUNCEMENTS:

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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

FRIDAY, NOVEMBER 4, 1904.

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